BRAIN.

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Original Articles and Clinical Cases.

THE ENDOGENOUS FIBRES OF THE HUMAN SPINAL CORD (FROM THE EXAMINATION OF ACUTE POLIOMYELITIS).

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The origin, course and destination of the fibres of the spinal cord which connect its neighbouring or more remote segments with one another (internuncial), or pass from one side to the other (commissural), have been extensively studied by experiments on animals, either by following their degeneration after the local destruction of the grey matter from which they arise, or by the method of successive degeneration which was introduced by Sherrington. It is probably the latter method that has given the most complete and accurate results as far as the descending spinal fibres are concerned, for by it the propriospinal fibres can be easily separated from those that descend from higher levels of the nervous system. As other methods, however, it fails to distinguish ascending fibres which terminate, as well as take origin in the cord, from those that pass into the brain-stem.

The methods of secondary degeneration after local destruction of the grey matter that have been employed depend largely on the now well recognized fact that grey and white matter are unequally vulnerable to various noxious influences, and especially to anæmia, and that extensive necrosis of the former may be produced without the destruction of the medullated fibres that pass through the injured region. Thus Ehrlich and Brieger and the many who repeated their experiments were able, by compressing for a time the abdominal aorta of the rabbit, to obtain complete anæmic necrosis of the grey matter

of the sacral and lumbar segments of the cord without any degeneration of the medullated fibres that pass through them. This experiment is possible, however, only in rabbits, and it is only in the lower segments of the cord that the destruction can be thus produced, but it has given valuable anatomical information on the course of the fibres that spring from these segments.

Münzer and Wiener have produced similar lesions in rabbits and dogs by the injection of normal sterile saline solution, but though the mechanical effects of this local injection fall chiefly on the grey matter, certain fibres of the white columns may be destroyed or injured by the insertion of the injection needle. Finally, Lamy, and later Rothmann and others, have attempted to determine the course and arrangements of the propriospinal fibres by producing local necrosis in the grey matter of the cord by the injection of granular substances, such as lycopodium powder, into the spinal arteries; but fibres of the white columns were frequently injured by this method.

Anything we know of the endogenous and the propriospinal fibres of the human cord is deduced from our knowledge obtained by these experiments on animals, or by the process of exclusion, as the course of the longer spinal systems is now fairly accurately known. Any direct observations, therefore, that can confirm or amplify these indirectly obtained conclusions must be valuable and desirable.

In acute poliomyelitis we have a disease which, though rarely limited to the grey matter of the cord, produces its destructive effects chiefly in it, and rarely interrupts or produces directly secondary degeneration of the fibres of the white columns. Further, we know that in the severer cases at least the destructive process is not limited to the ventral horns, as the title poliomyelitis anterior acuta suggests, but may, and frequently does, involve the intermediate grey matter and the dorsal horns. Finally, though the lesions are, as a rule, diffuse and widespread in the fatal cases, small and isolated foci of disease may be usually found in certain regions. Consequently by the histological examination by Marchi's method of a sufficient number of recent and suitable cases, it should be possible to determine the distribution and destination of the endogenous spinal fibres that take origin from the affected portions of the grey matter of the spinal cord, the regions in the cross section of the cord that the endogenous fibres as a whole occupy, and those tracts in the cord that contain no endogenous fibres.

Owing to the diffuse and widespread nature of the primary lesions

these cases cannot be of much value in settling many anatomical points, and we employ them to throw light on points on which we have otherwise obtained little direct information.

We have been able as yet to examine by Marchi's method only three suitable cases, but the anatomical facts that their study has brought out seem sufficiently interesting to warrant their publication, especially as hitherto a similar systematic examination has been made only by Bing in a single case. Further, while some of our positive conclusions are beyond doubt, the disease was sufficiently extensive in our cases to justify certain negative statements.

All these patients died in the Hospital for Sick Children, Great Ormond Street, under the care of one of us (F. E. B.). The following short *résumés* contain sufficient details of their clinical histories:—

Case 1.—W. B., aged 7, became ill with fever and headache on August 17, 1905; two days later it was found that he lost power in his legs, and on August 22 he was admitted to hospital. Then the flaccid paralysis was limited to his legs, but on September 20 he became drowsy, developed incontinence of urine and fæces, and respiratory difficulty, and eventually he died on September 28, six weeks after the onset of the disease.

On examination there was found very extensive destruction of the grey matter of the lumbo-sacral enlargement and of the lower dorsal region, and similar but more recent lesions were found in the cervical enlargement.

Case 2.—R. A., aged 10 months, was taken ill on October 14, 1909, but weakness was noticed only two days later. On October 17 she could not hold up her head or even cry, and when she was admitted to hospital five days later there was almost complete paralysis of the legs and of the left arm, as well as of the abdominal and thoracic muscles. She developed broncho-pneumonia and died on November 16, a month after the onset of the paralysis.

In this case there was extensive destruction of the grey matter, especially in the lumbar and dorsal segments, but it extended as far caudalwards as the third sacral segment and into the highest cervical region. Deiters' nucleus was also involved on both sides, but no other destructive foci were detected in the brain-stem.

Case 3.—S. C., aged 1 year and 9 months, became ill on November 19, 1909, and was unable to stand on the following day; the right arm was also affected and he was unable to hold his head up. When admitted to hospital fourteen days later he had flaccid paralysis of his left leg, but his right leg, his arms and the muscles of his trunk had partially recovered. On December 19,

however, he developed diphtheria and died from diphtheritic paralysis two and a half months after the onset of the paralysis.

There was considerable destruction in the ventral horns of the lumbar segments, and a less severe affection in the cervical region. The disease was, however, not extensive and involved the dorsal horns only in the lumbar segments. There were no lesions in the brain-stem. The Marchi method showed fine granular degeneration in the dorsal roots, especially in those of the lumbo-sacral enlargement, but it could not be traced as a true secondary degeneration up the dorsal columns. It had the histological characters of the fatty degenerative changes found in these medullated fibres in toxic states, and is to be undoubtedly attributed to the diphtheritic intoxication.

In all these cases the microscopical changes were characteristic of acute poliomyelitis, and these are now so well known as not to require further description.

In each of the cases several segments were examined by Marchi's method, while certain regions were cut in serial sections. The brain-stems were also cut serially; in Case 2 these sections extended to the middle third of the optic thalamus, but in Case 1 the brain was not examined above the anterior quadrigeminal bodies, and in Case 3 only to the posterior quadrigeminal region. As practically the same changes were found in all cases, they may be described together.

Spinal Cord.

The most prominent change visible in Marchi preparations in the segments in which there was extensive destruction of the grey matter was degeneration of the ventral spinal roots (figs. 1 and 2); these degenerated fibres could be frequently followed from various portions of the ventral horns through the ventral columns, but neither their arrangement nor course presented features worthy of special mention. In regions where the disease was unilateral there was no evidence of root-fibres taking origin in one ventral horn and after decussation passing into the opposite ventral roots.

In two of our cases, however, we had an exceptional opportunity of observing the origin and the course of the fibres of the spinal portion of the spinal accessory nerve, as these fibres were degenerated and were consequently easily traced by Marchi's method. The nucleus of origin and the intramedullary portions of the fibres could be followed through the upper six cervical segments. In the lower segments,

FIG. 1.

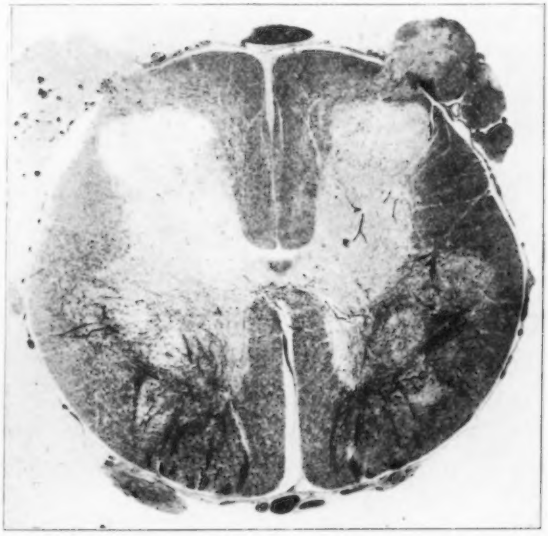

FIG. 2.

Photographs of Marchi preparations of the second sacral and third lumbar segments of the spinal cord to show the extensive destruction of grey matter, and the secondary degeneration that has resulted from it.

the sixth, fifth, and fourth, these root-fibres could be traced from a group of cells lying in the ventrolateral part of the ventral horn (fig. 7), and from it they passed horizontally, or slightly obliquely dorsalwards, to the base of the dorsal horn, where some of them bend cerebralwards to form a compact bundle, or a group of smaller bundles, which could be traced to the upper end of the spinal cord (fig. 8); they are easily recognizable in normal specimens. In the lower segments in which

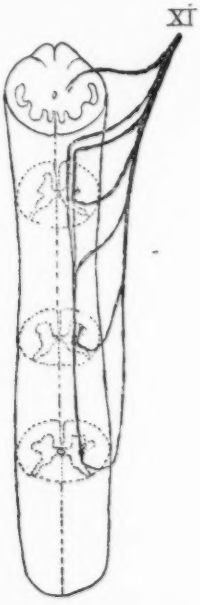

FIG. 3.

Diagram of the course of the root-fibres of the spinal portion of the spinal accessory nerve.

they are found, these transversely cut fibres lie embedded in the neck of the dorsal horn, while in the higher cervical segments some occupy the inner part of the formatio reticularis of the lateral column (fig. 8). But at certain levels along its course certain fibres pass from this intramedullary bundle horizontally, or somewhat obliquely upwards, through the lateral columns to form the extramedullary portion of the root. In the lower segments these fibres generally run along the lateral border of the dorsal horns (fig. 7), but in the higher many

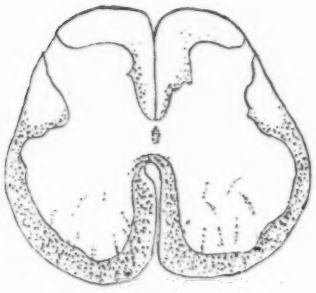

FIG. 4.

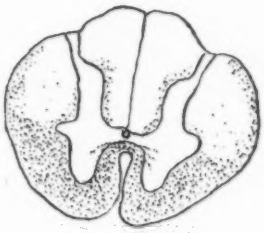

FIG. 5.

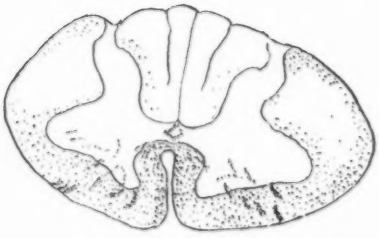

FIG. 6.

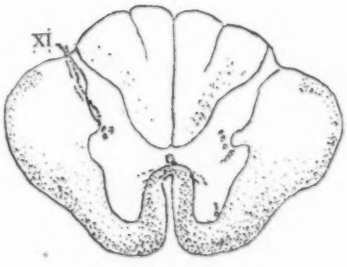

FIG. 7.

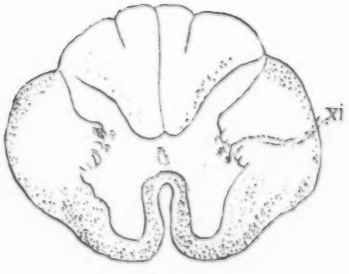

FIG. 8.

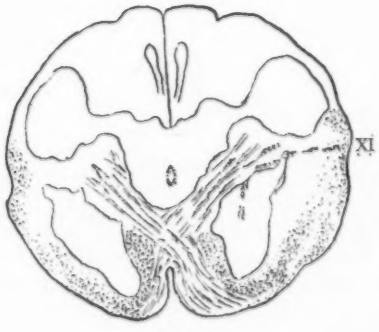

FIG. 9.

Drawings from Marchi preparations of the position of the degenerated fibres in different segments of the spinal cord.

pass directly lateralwards through the lateral columns as Kölliker has described (figs. 8 and 9); but root-fibres passing in both directions were occasionally present in the same section. We could, however, trace some fibres directly from their nucleus of origin to the periphery of the cord, unconnected with the intramedullary bundle.

Towards the upper end of the spinal cord this intramedullary bundle disappears owing to its fibres passing outwards to join the rest of the root, but some of its fibres could be traced as high as the decussation of the pyramids (fig. 9). Thus the root-fibres of the spinal accessory nerve run cranialwards in two parallel bundles, the one intra- the other extra-medullary, which are connected at short intervals by fibres passing from the former to the latter (fig. 3). It is always difficult to determine accurately in Marchi preparations the exact origin of root-fibres, but our observations conform with those of Bunzl-Federn and Sano, who found the lower fibres connected with cells in the ventrolateral part of the ventral horn, and some of the higher coming from a group more in the centre of the horn. Roller recognized that certain of the root-fibres of the spinal accessory nerve take a longitudinal course within the spinal cord before their exit, and Darkschewitsch has described this more fully by studying their myelinization in human fœtuses. He noted too that the apparent origin of the root-fibres from the middle cervical segments may vary, as the proportion of fibres that ascend in the spinal cord before their exit is not constant. Van Gehuchten has discovered an exactly similar course of the root-fibres in lower mammals (rabbit) as that which we describe in man by tracing their retrograde degeneration after the main root had been torn out at the side of the bulb; and Cajal has, by the aid of Golgi's method, made out the same course in the cat and rabbit.

The ventrolateral columns of each cord contained a large number of degenerated fibres; the majority of these ran longitudinally, but some could be traced into the ventral commissure. They were most numerous in the segments in which the grey matter was most severely involved and gradually diminished in number as they were traced into segments in which there was less disease. In every instance the degenerated fibres were densest in the ventral columns, ventral and ventrolateral to the ventral horn; in the sacral and lumbar segments, which were generally most affected by the disease, these regions were diffusely strewn with granules stained black by osmic acid (fig. 4). They were always most closely packed in the immediate neighbourhood of the affected grey matter, while in regions in which there was less

inflammatory change, as in the higher cervical and in some of the dorsal segments (figs. 7 and 8), they were separated from it by a zone of normal fibres. The majority of these degenerated fibres are internuncial, and their arrangement evidently depended on the law that the longer fibres lie more peripherally in the cord, while the shorter, that connect only adjacent segments, remain close to the grey matter.

In the severely affected regions of the cord, where the degenerated fibres were scattered diffusely throughout the ventrolateral columns, no definite systematization could be recognized, but in the less involved regions the longer fibres ascending from the more caudal segments to the upper portion of the cord or to the brain-stem, could be distinguished on the periphery of the ventral columns. The most dorsal of these fibres spread into the lateral columns, and in the higher cervical segments were separated from the periphery by the ventral borders of the ventral spinocerebellar tracts (figs. 8 and 9).

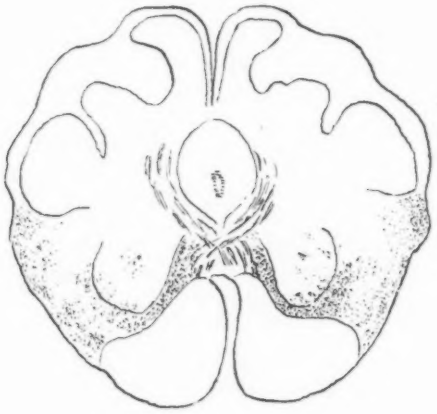

FIG. 10.

It was impossible to distinguish ascending and descending fibres in degeneration except in regions in which there was little primary disease, or above or below its level. In one case in which the sacral segments were almost spared the extensive degeneration they contained was evidently predominantly descending, while that found in the higher segments when these escaped was ascending. Evidently large numbers of both ascending and descending propriospinal fibres exist.

In two of the cases the degenerated fibres were displaced lateral-

wards from the ventral fissure in the upper half of the cord by the presence of a large direct ventral corticospinal tract.

In the three cases there was also bilateral degeneration of the spinocerebellar tracts which we could follow from the lower dorsal segments of the cord to their termination in the cerebellum; the ventral and dorsal tracts were about equally affected. The existence of the diffuse degeneration in the lateral columns already described made our material unsuitable for the accurate investigation of the relations of these tracts in the spinal cord, but they were easily identified where they separated from the spinal fibres in the medulla oblongata and in the cerebellum (figs. 11 and 12).

The region of the ventrolateral column which in all our cases contained least degenerated fibres was that occupied by the crossed pyramidal tracts, in which at the most only a few isolated fibres were affected, and in the white matter immediately on the lateral border of the dorsal horns. This latter would correspond to Bechterew's "median bundle"; it was only in the immediate neighbourhood of severely affected grey matter that this region contained any considerable number of degenerated fibres.

Commissural fibres.—In addition to the longitudinal fibres of the cord, many of those of the ventral white commissure were degenerated, but only at or near those levels where the grey matter was involved. Frequently these degenerated fibres could be traced from one ventral horn through the commissure into the opposite ventral column, in which they appeared to become oblique.

Dorsal columns.—The state of the dorsal columns of the cord in acute poliomyelitis, which it is now recognized produces foci of degeneration in all parts of the grey matter, is of special interest, as it may throw light on the vexed question of the distribution of the endogenous spinal fibres that these columns contain. Considering the frequency of dorsal root degeneration in toxic and acute infective states, it was surprising that in only one of our cases was there any noteworthy affection of these fibres.

In all the cases the dorsal columns were freer from degeneration than any other region of the cross section of the cord; in none of them could any ascending degeneration be detected in Goll's columns in the cervical region, and the longer descending tracts—Schultze's comma, Hoche's peripheral bundle, Flechsig's oval field, and Gombault and Philippe's triangle, contained not a single degenerated fibre. Marchi preparations showed only diffusely scattered granules near the grey

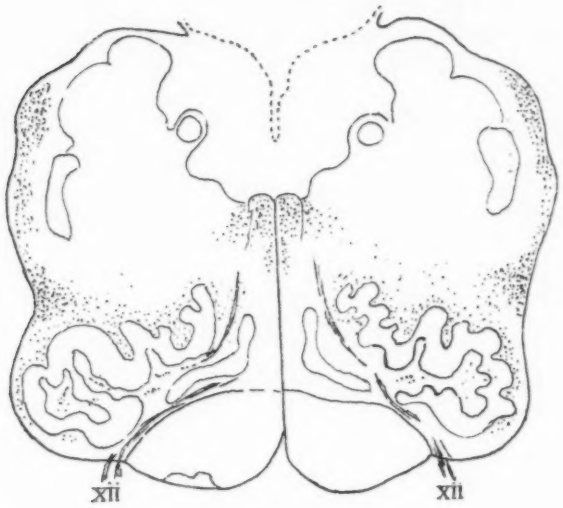

FIG. 11.

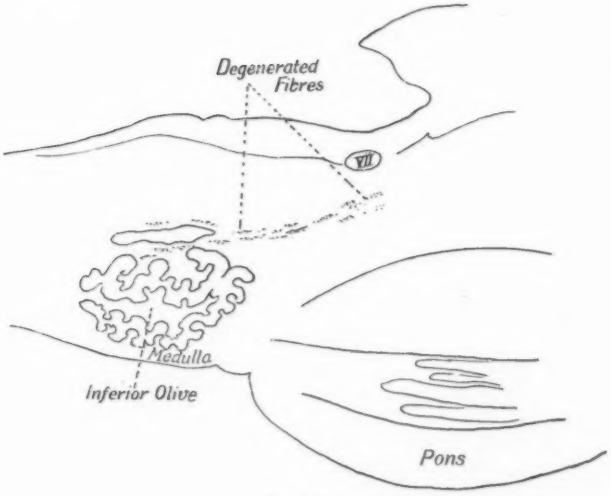

FIG. 12.

Longitudinal sagittal section of the medulla oblongata in the plane of the dorsal vagus nucleus.

matter along the ventral half of the dorsal horns, and especially in the cornu-commissural angle. In these regions the amount of degeneration corresponded roughly with the amount of local disease in the grey matter (figs. 4 and 5).

This complete absence of degeneration in the longer ascending and descending tracts of the dorsal columns is strong evidence that these regions contain only exogenous or radicular fibres. Whether the descending tracts are composed wholly of radicular fibres has been for long a much debated question. Early observers, as Tooth and Marie, together with Schaffer, Nageotte, and Gombault and Philippe, came to the conclusion that they are chiefly endogenous; while Schultze, Redlich, Zappert, and Goldstein believed they are wholly exogenous. Others, as Dejerine and Spiller, Marburg, Wallenburg, and Bruce, assert that these descending systems contain both endogenous and exogenous fibres. Collier and Buzzard, Homén and others have demonstrated exogenous fibres within them, but are not certain if they contain propriospinal fibres as well. The complete absence of degeneration in them in our cases necessitates the alternative conclusions that either their fibres are wholly exogenous, or that the portions of grey matter from which they take origin escaped completely. The latter alternative is extremely improbable in view of the wide distribution of the disease. Further, in Bing's case of acute poliomyelitis also these columns contained no affected fibres, and the only degeneration in the dorsal columns was of the same distribution as we describe. Finally, these tracts have not been found to be degenerated in animals in which the grey matter of the cord was destroyed by cutting off its blood supply (Ehrlich and Brieger), by embolism of the spinal arteries (Rothmann), or mechanically (Münzer and Wiener). It is true that these experiments were carried out chiefly on the lower mammals, but the dorsal columns of these animals apparently contain long descending fibres similar in distribution to those that exist in the higher mammals. We must therefore accept the conclusion that the system of descending fibres contained in Schultze's comma, Hoche's bundle, Flechsig's oval field, and Gombault and Philippe's triangle are wholly of exogenous or root origin. We also failed to find the long ascending endogenous fibres running near the septum that have been described by Münzer and Wiener, and by Rothmann in lower mammals. In man at least the endogenous fibres of the dorsal columns lie in the zone adjacent to the ventral half or two-thirds of the dorsal horns and in the cornu-commissural region, and seem to have a short course only.

Brain-stem.—The degenerated fibres that pass cerebralwards from the spinal cord were easily traced to their termination in the serial sections; this was especially so in Case 3, in which the brain-stem was divided by a mesial incision and the one-half cut in the sagittal, the other in the horizontal plane. Unhappily in Case 2 inflammatory foci had destroyed Deiters' nuclei on both sides and produced degeneration

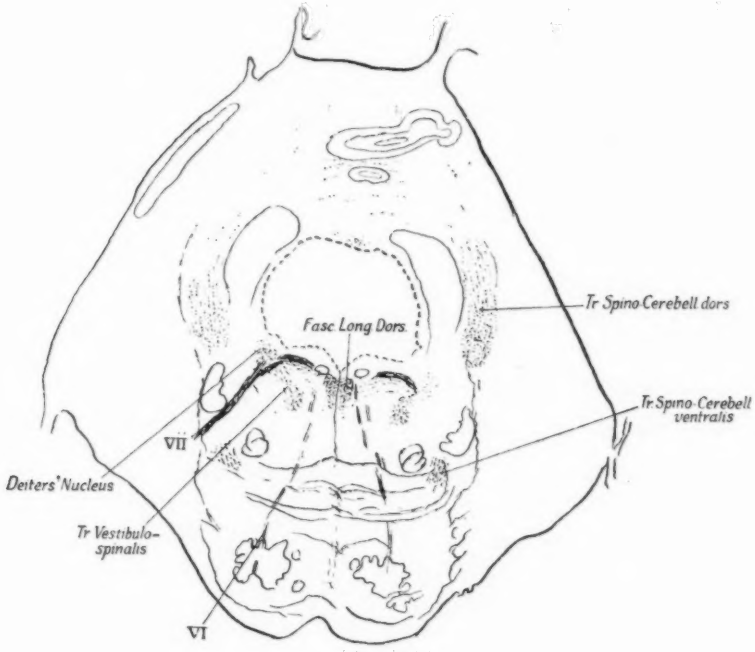

FIG. 13.

Transverse section of the pons varolii and cerebellum to show the degeneration resulting from local lesions in Deiters' nuclei, and the degeneration ascending from the spinal cord in the spinocerebellar tracts and the dorsal longitudinal bundles.

of the fibres that take origin in them (fig. 13); but recognizing this it was easy to distinguish the degenerated spinal fibres, especially by correlating the findings with those in the other two cases.

As the upper cervical segments were little affected in our cases, the degenerated fibres that passed through them from lower segments of the cord were arranged mainly in the periphery of the ventral columns and in the spinocerebellar tracts. The latter were followed to the

vermis of the cerebellum, but we have nothing new to add on either their course or destination.

The degenerated fibres of the ventrolateral columns maintain the same relative position around the ventral horns till these disappear, lying close to them on the mesial side but separated from them laterally by a relatively normal zone (fig. 9). They are, however, displaced lateralwards and dorsalwards from the ventral fissure by the corticospinal tracts when these attain their ventral position in the pyramids (fig. 10). At the lower end of the inferior olives these degenerated fibres, which to this level had lain as a crescentric band around the ventral horns, divided into two groups between which only sparse and irregularly arranged fibres were found (fig. 11). The one group lay around the inferior olives, chiefly dorsolateral to them, and between them and the dorsal accessory olives; the other group passed into the dorsomedian portion of the cross-section of the medulla, and its fibres entered the dorsal longitudinal bundle, or ran ventral to this on the side of the raphe, but a certain number remained scattered in the adjacent parts of the formatio reticularis (fig. 11).

The fibres of the ventrolateral group diminished rapidly in number as the olives increased in size; their destinations, as far as could be determined in Marchi preparations, were: (1) In the inferior olives and probably in the dorsal accessory olives. Many fibres could be seen to bend transversely, pierce the myelinated capsule of the olive and enter its grey matter; while other degenerated fibres seemed to enter the hilum of the olives and reach its grey matter from within. The greater number of these fibres terminated in the lower third of the olives, but a few could be followed to its oral half. (2) Other fibres that lie dorsal and dorsolateral to the inferior olives are not sharply separable from the spinocerebellar tracts in the lower part of the medulla; these seem to end gradually in the ventral portion of the formatio reticularis, but a considerable number pass through the nuclei laterales medullæ and some probably terminated in them. (3) A small bundle of degenerated fibres, which was first traced in the sagittal and horizontal series and was later identified in one of the transverse series, passed off from those that surround the inferior olives at about the middle third of the latter, obliquely cerebralwards and dorsalwards through the formatio reticularis, approximately in the plane of the dorsal vagus nucleus. They could be traced between the roots of the sixth and seventh nerves, and seemed to end in the grey matter that lies here in the dorsal half of the formatio reticularis, and perhaps in the nucleus centralis inferior

(fig. 12). These are the destinations, as far as they could be ascertained in Marchi sections, of the fibres of the ventrolateral group. They have all, with the exception of the third bundle, ended at about the upper third of the medulla oblongata, or at least at the lower margin of the pons.

The dorsomesial group could be traced further cerebralwards, but at about the middle of the medulla oblongata those fibres contained in the formatio reticularis began to disappear rapidly, terminating apparently in its grey matter. In one of the cases a few fibres could be followed immediately under the grey matter of the fourth ventricle and aqueduct, lateral to the dorsal longitudinal bundle, throughout the pons and midbrain into the caudal portion of the optic thalamus; in the upper part of the midbrain, these fibres, which were few in number, lay on the mesial side of Forel's bundle, while they entered the thalamus in the dorsomesial portion of Forel's field. As far as we could trace them they seemed continuous with the fibres of the ventrolateral column of the cord, but in the case in which we found them there were symmetrical lesions in Deiters' nuclei, but no other foci of disease that we could discover in the brain-stem. The degenerated fibres in the dorsal longitudinal bundles diminished in number rapidly at the lower end of the pons, especially at about the level of the sixth nerve nuclei, but some could be traced into the midbrain.

The anatomical significance of the degenerations found in the spinal cord, and especially those in the dorsal columns, has been already discussed, and some reference may be now made to those fibres of spinal origin which we have traced into the brain-stem. Excepting the spinocerebellar tracts the most prominent of these were those ascending from the ventrolateral columns that terminate in the inferior olives and their accessory nuclei. These fibres have been described by Bechterew, Dydynski, Collier and Buzzard, and Page May. Our observations agree closely with Dydynski's, as the "Olivenbundel" which he traced in man from the midthoracic region, lay near the exit of the ventral roots, and there was no doubt that it was the more lateral of the spinal fibres that we traced to the olives.

Many authors who have traced by the degeneration methods fibres from the spinal cord into the brain-stem have been struck by the considerable number which apparently terminate in the formatio reticularis; the majority of these end irregularly and cannot be grouped into bundles or definite systems. Sherrington and Cajal have seen some of these fibres enter the nuclei laterales of the medulla. We have not

been able to trace any of these fibres of spinal origin directly to the nuclei of the vagus or acusticus nerves, or to Deiters' nucleus as Rothmann has described.

We have been unable to find any previous reference to, or description of, the compact bundle of fibres which we traced in two cases from the ventrolateral columns of the cord, dorsal to the inferior olive, towards the nucleus centralis inferior. In neither of the cases in which we found it were there any local medullary lesions to which the degeneration could be due.

Fibres have been also repeatedly traced from the ventral columns of the cord into the dorsal longitudinal bundles, but they have been rarely followed as high as the midbrain. Rothmann, for instance, saw them disappear in the upper half of the pons, but Collier and Buzzard traced a few as high as the posterior commissure.

The few degenerated fibres we followed through the brain-stem ventral to the central grey matter, lateral to the dorsal longtitudinal bundles, are hitherto undescribed in man, but as in the case in which we found them there were lesions in the brain-stem, *i.e.*, in Deiters' nuclei, we cannot be certain they came from the spinal cord. Lewandowsky describes the fibres of Forel's bundle as extending from the inferior olive through the lateral portion of the formatio reticularis, and this course corresponds closely with that of those fibres we found degenerated in these cases.

Conclusions.

(1) The spinal portion of the spinal accessory nerve has a large intramedullary root which extends throughout the upper five or six cervical segments of the spinal cord.

(2) The longer descending systems of the dorsal columns—Schultze's comma tract, Hoche's marginal bundle, Flechsig's oval field, and Gombault and Philippe's triangle—do not contain endogenous fibres in man.

(3) The propriospinal fibres of the ventrolateral columns are arranged in man as in other mammals, and conform in their arrangement to the law that the longer fibres lie nearer the surface of the cord.

(4) Many fibres of the ventrolateral columns ascend to the brain-stem and terminate in the inferior olives, in the formatio reticularis bulbæ et pontis, in the nucleus centralis inferior, and probably in the nuclei laterales of the medullæ ; others ascend in the dorsal longitudinal bundles as high as the midbrain.

BIBLIOGRAPHY.

[1] v. Bechterew. "Die Leitungsbahnen im Gehirn und Rückenmark," Leipzig, 1894.
[2] *Idem. Neurol. Centralbl.*, 1901, Bd. xx, S. 645.
[3] Bing. *Arch. f. Psychiat.*, 1905, Bd. xxxix, S. 74.
[4] Bruce. *Rev. neurol.*, 1900, t. viii, p. 691.
[5] Bunzl-Federn. *Monatsschr. f. Psychiat. u. Neurol.*, 1897, Bd. ii, S. 427.
[6] Cajal. "Histologie du Système nerveux," Paris, 1909.
[7] Collier and Buzzard. *Brain*, 1903, vol. xxvi, p. 559.
[8] Darkschewitsch. *Arch. f. Anatom. u. Physiol.*, Jahrg. 1885, Anatom. Abth., S. 361.
[9] Dejerine et Spiller. *Compt. rend. de la Soc. de Biol.*, 1895, p. 622.
[10] v. Dydynski. *Neurol. Centralbl.*, 1903, Bd. xxii, S. 898.
[11] Ehrlich und Brieger. *Zeitschr. f. klin. Med.*, 1884, Suppl. Bd. vii, S. 155.
[12] van Gehuchten. "Anatomie du système nerveux de l'homme," 4me Ed., Louvain, 1906.
[13] Goldstein. *Monatsschr. f. Psychiat. u. Neurol.*, 1903, Bd. xiv, S. 401.
[14] Gombault et Philippe. *Arch. de med. experim.*, 1894, t. vi, p. 365.
[15] Homén. *Deutsche Zeitschr. f. Nervenheilk.*, 1901, Bd. xx, S. 24.
[16] Kölliker. "Handbuch der Gewebelehre," 2te Bd., 6te Aufl., Leipzig, 1896.
[17] Lamy. *Arch. de Physiol.*, 1895, Series 5, t. vii, p. 77.
[18] Lewandowsky. *Neurol. Arbeiten*, 1904, Bd. i, S. 63.
[19] Marburg. *Jahrb. f. Psychiat.*, 1902, Bd. xxii, S. 243.
[20] Marie. "Lectures on Diseases of the Spinal Cord," English Trans., London, 1895.
[21] May. *Brain*, 1906, vol. xxix, p. 742.
[22] Münzer und Wiener. *Monatsschr. f. Psychiat. u. Neurol.*, 1910, Bd. xviii, S. 1.
[23] Nageotte. *Nouv. Iconogr. de la Salpêtrière*, 1904, t. xvii, p. 17.
[24] Redlich. *Jahrb. f. Psychiat.*, 1892, Bd. xi.
[25] Roller. *Zeitschr. f. Psychiat.*, 1881, Bd. xxxvii, S. 469.
[26] Rothmann. *Arch. f. Anatom. u. Physiol.*, Physiol. Abth., 1899, S. 120.
[27] *Idem. Neurol. Centralbl.*, 1903, Bd. xxii, S. 744.
[28] Sano. "Les localisations des fonctions motrices de la moelle épinère," Bruxelles, 1898.
[29] Schaffer. *Monatsschr. f. Psychiat. u. Neurol.*, 1899, Bd. v, S. 22.
[30] Schultze. *Arch. f. Psychiat.*, 1883, Bd. xiv., S. 359.
[31] Tooth. *Brit. Med. Journ.*, 1889, vol. ii, p. 825.
[32] Wallenberg. *Deutsche Zeitschr. f. Nervenheilk.*, 1898, Bd. xiii, S. 441.
[33] Zappert. *Neurol. Centrabl.*, 1898, Bd. xvii, S. 102.

A CONTRIBUTION TO THE PATHOLOGY OF CHRONIC PROGRESSIVE CHOREA.

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CHRONIC progressive chorea is a curious affection which occurs comparatively late in life, characterized by irregular movements, disturbance of speech, and an accompanying psychical derangement, terminating gradually in dementia. Homogeneous heredity is not always present, although of frequent occurrence.

While it is generally conceded that the disease has no well-founded relation to Sydenham's chorea, and should be regarded as a nosological entity *per se*, some writers (Monnier) still contend that this distinction should not be made.

Much interest lies in the pathology of the disease, but the anatomical lesions found at *post-mortem* vary greatly, making it difficult to judge of their respective values.

Following is a report of the pathological findings in two cases of chronic degenerative chorea. Only a brief *résumé* of the clinical histories will be given.

Case 1.—C. S., male, labourer, admitted November 20, 1907, died January 8, 1913. Concerning the family history of the patient, other than the fact that his father was alcoholic, but little definite information could be obtained. Patient was born in the State of Ohio, in 1841. His early childhood was uneventful; he learned to walk and talk when 1½ years old. Whilst a child he had no convulsions or fits. He began school at the age of 6 years, learned to spell with difficulty, but succeeded fairly well with his studies, and was of a sociable disposition. He enlisted in the Army at 23 years of age, and served two years. His habits were good; no history was obtained of syphilis, sexual excesses, or the abuse of drugs. The onset of his illness was gradual, the first choreic movements being noticed at the age of 52; they gradually increased in severity and extent. When admitted to this hospital, physical examination showed the patient to be of a strong frame, but poorly nourished. The pupils were equal and slightly dilated; accommodation was normal, and direct and consensual reactions for light were unaffected. No pronounced anomalies of the ears were evident, but the palate was high and narrow. Exaggeration of the

deep reflexes was evident and of the superficial slight. The chest was well formed and symmetrical. Respiratory organs showed nothing abnormal upon percussion and auscultation. The heart was not obviously enlarged. A slight aortic murmur, however, was perceptible. Pulse 80 per minute, somewhat irregular. Examination of the abdomen and genito-urinary tract was negative. Temperature normal. Integument dry. Hearing, taste and smell normal. Urine: colour pale yellow; acid reaction, specific gravity, 1010; trace of albumen; no casts but a few leucocytes.

Throughout the patient's residence in this hospital his choreic movements were a prominent feature. His gait was erratic and uncertain, and somewhat resembled that of a drunken man. Peculiar gestures, poses and irregular jerking of the muscles were continuously present. They were increased by embarrassment and emotion, but lessened in repose and subsided during sleep. His mental state was that of depression and he gave evidence of a suicidal tendency. He became irritable without appreciable cause, used profane language, and assaulted other patients without provocation. His speech was thickened and drawling in character. He was untidy in his person and dress. Delusions of persecution were evident. His memory was weakened, and judgment and reasoning defective. Progressive mental and physical enfeeblement supervened, and the patient died January 8, 1913, after the disease had lasted for twenty years.

Post-mortem Record.

External examination.—Body large and well nourished.

Internal examination.—Head: The calvarium was symmetrical, wall thick, diploe compact. Dura, somewhat adhered to skull, thickened. Inner surface smooth. Pia, showed a slight opacity over the convexity of the brain, and the cerebrospinal fluid was slightly increased.

Brain: Weight 1,030 grm. Slight general atrophy was present. No decortication occurred upon removal of the pia. The basal vessels showed but slight sclerosis. The lateral ventricles were not dilated. No granular ependymitis of the lateral or fourth ventricles.

Spinal Cord: Considerable diminution in the size of the spinal cord was evident. Otherwise, no macroscopical lesions could be detected.

Thorax: Pericardium normal. Heart, weight 350 grm. Right auricle enlarged. Tricuspid orifice admits four fingers, valve somewhat thickened. Right ventricular wall thickened, cavity enlarged. Pulmonary valve normal. Left auricle enlarged. Mitral orifice admits three fingers. Mitral valve thickened. Left ventricular wall thickened, cavity dilated. Aortic leaflets thickened and slightly atheromatous.

Lungs, weight 550 grm.—left 510 grm.—slight hypostatic congestion, œdema, and emphysema.

Liver, weight, 1,300 grm. Surface smooth, capsule thickened. Fatty infiltration. Gall-bladder normal. Spleen, weight 150 grm. Capsule thickened, surface smooth, pulp soft and red in colour. Pancreas normal. Stomach and intestines normal.

Genito-urinary tract: Kidneys, weight, right 80 grm., left 130 grm. Left kidney, capsule somewhat adherent, surface granular, cortex narrow and ill-defined. Numerous small cysts present. Pelvic fat increased. Right kidney small, contracted, capsule strips with difficulty, surface irregular, cortex thin. Large cyst in lower portion. Bladder, slight congestion of mucous membrane.

Microscopical Examination.

Numerous pieces from different regions of the brain and spinal cord, together with parts of the radialis, ulnaris, medianus, ischiadicus, and cutaneous femoris posterior nerves were fixed in alcohol, formal, Weigert's mordant, Müller's fluid, Orth's fluid, and special fixing reagents. The following staining methods were utilized: thionin, toluidin blue, cresyl violet, polychrome methylene blue, Van Gieson, Unna-Pappenheim's, Weigert's resorcin-fuchsin, Alzheimer's for glia, Herzheimer's, Bielschowsky's, Weigert's for neuroglia fibres, Weigert's myelin-sheath, Marchi's, Mallory's, Mann's, Heidenhain's, hæmatoxylin, gentian violet, and others.

Precentral gyre: With Van Gieson's stain a diffuse connective tissue thickening of the pia is present, with toluidin blue numerous large fibroblasts are seen which contain a considerable amount of lipoid material within their cytoplasmic processes.

A study of the cellular elements in this area indicate that degenerative changes are evident in the cells throughout, but especially in the deeper layers of the cortex. Only a few of the Betz giant cells, however, show degenerative changes.

The commonest and most extensive change occurring in the degenerated ganglion-cells is that affecting the Nissl substance. A general chromatolysis is frequently seen, not only in the cell body, but extending for some distance into the protoplasmic processes. This consisted in a breaking up of the tigroid substance into small darkly stained granules, distributed more or less regularly throughout the cell body. Around the periphery of the cell bodies, the Nissl corpuscles in

some of the cells are fairly well preserved. The nuclei also present some interesting changes. The nuclear membrane is sometimes hardly discernible, and the contour of the nucleus irregular. In some, small blue granules can be seen lying in the nucleoplasm. The nucleus often occupies a position near the periphery of the cell, in some cells staining more deeply than normal, and in other cells vacuolar degeneration is apparent. Many cells show an abnormal increase of lipoid material. This substance appears as irregular masses lying within the meshes of a violet stained, net-like structure into which the entire cytoplasm of some of the cells is converted. In the cells the nuclei are eccentrically located and show pathological changes, and the apical processes present an unusually tortuous aspect.

A more or less general shrinkage characterizes the changes in many cells. The cytoplasm and processes are filled with darkly stained coarse granules. Some are shrunken to such an extent as to present a rod-like appearance. Vacuolar degeneration is present in a few cells; in some cases the vacuoles are large; in other instances the cell body is filled with numerous small vacuoles; the protoplasmic processes have disappeared and the nucleus is deformed and shrunken, and a more or less well-defined pale area is seen surrounding the nucleus. A considerable increase of the chromatin granules within the nucleus can be observed. Sometimes a chromatin network occurs in parts of the nucleus. Not infrequently the nucleus contains small vacuoles, the nucleolus is enlarged, and lies close to the nuclear membrane.

Sclerosis of the ganglion-cells is also evident. When stained with Nissl toluidin blue the nuclei are darkly stained and present a pyramidal shape. The cytoplasm is often so darkly stained in the region of the nucleus that the limits of the latter are quite indistinct. The nucleoli are greatly increased in size. The apical processes are tortuous and can be traced for an unusual distance. The axis cylinder processes are shrunken. The tigroid substance is frequently clumped in masses within the cell body.

In Bielschowsky preparations the entire cell appears more darkly stained than normal. The nucleus presents a triangular shape and is darkly stained. A net-like structure surrounding the lipoid granules is also discernible.

Many cells are swollen and the Nissl substance lightly stained. The nucleus and nucleolus are enlarged and faintly stained. The protoplasmic processes and axis cylinder can be traced for a considerable distance. The cytoplasm is seen to consist of a fine granular

structure. These cells are not so deeply stained by the Bielschowsky method as those which have undergone sclerotic changes. The cytoplasm is pale and the neurofibrils scarcely perceptible. The nucleus is large, pale and presents an oval or round form. Groups of small granules are often seen within the nucleus. The nucleolus is enlarged and occupies an eccentric position; sometimes it is darkly stained and in other instances of a light brown colour. Here and there cells are seen in which only a faintly stained ring of cytoplasm remains surrounding the nucleus.

An increase of the glia-cells is readily discerned. This hyperplasia is seen to be most pronounced in the deeper layers. The predominating type is the small non-fibre building glia-cells, having an intense darkly stained nucleus, surrounded by a scanty, somewhat densely stained irregular cell body. Sometimes the cytoplasm is composed of vacuoles or cysts containing masses of fat. This fatty material stains a yellowish, or yellowish-green colour, by toluidin blue and usually lies on one side of the nucleus. The protoplasmic processes are occasionally seen to contain groups of cysts filled with fat granules at some distance from the cell body.

Glia-cells having a large lightly-stained nucleus are seen, but are not so numerous in general as the small glia-cells. The nucleolus is large and is often metachromatically stained, or several nucleoli can be observed lying among the blue stained chromatin granules. The cell body is more or less ill-defined, although more copious than in the smaller cells, and, especially in those cells surrounding degenerated ganglion-cells, is seen to contain numerous lipoid granules; occasionally glia-cells are seen having angular or dumb-bell shaped, small, darkly stained homogeneous nuclei.

The number of glia-cells in the vicinity of ganglion-cells is obviously increased. They generally occupy a position around the base of the cell. Ganglion-cells are not infrequently met with in the lower layers which have become swollen, deformed, and apparently invaded by glia-cells; i.e., a passive neurophagia is present. Sometimes one and occasionally several glia-cells can be found within the cytoplasm of the nerve cell.

A great increase in glia-fibres is perceived in sections stained by Weigert's method for neuroglia. The membrana glia superficialis is greatly thickened, and amyloid bodies are rather numerous. The increase of fibres, however, is most pronounced in the lower layers of the cortex and in the white matter. Some fibres are conspicuous for

their thickness and tortuous course. Around the blood-vessels an increase in the number and size of the glia-fibres is seen.

The nuclei of the endothelial cells of the vessels are darkly stained, shrunken, angular, sometimes round and sometimes lightly stained. The cell body of the endothelial cell is sometimes unstained and sometimes has quite a perceptible reticular structure. The meshes of the net-like structure are filled with yellowish and green coloured granules. Sometimes the endothelial cells appear to have completely disintegrated. Frequently the fat granules only lie around the border of the cell, and it seems as if in such instances a fatty infiltration of the cement substance had occurred.

The cells of the muscular coat of the vessels are in many instances degenerated and filled with fat. The adventitial cells are shrunken, darkly stained, and many of them contain products of disintegration, viz., lipoid material and basophilic metachromatic substance. Some of them are filled with unusually large irregular masses of fat, while others contain smaller granules more regular in size and shape.

A thickening and hyperplasia of the adventitial connective tissue, with swelling of the elastica, is evident in some of the vessels. Capillary knots and spiral formations are encountered. The adventitial spaces of many of the vessels, especially in the white matter, contain Körnchen cells filled, as a rule, with dark green coloured pigment.

The changes in the veins are similar to those in the arteries. Many of the adventitial cells are seen to contain greenish and yellowish granules of lipoid material.

By the Weigert-Pal method the cortex shows a rather diffuse falling out of medullated fibres. The supraradiary and tangential are especially sparse, in fact the latter seem to have entirely disappeared in some places. The oblique fibres forming the interradiary plexus are likewise diminished.

Examination of preparations from the post-central and para-central gyri show the pathological changes to be similar to those occurring in the precentral convolution. The alteration in the tangential fibres and the supraradiary plexus, however, appears to be somewhat less pronounced.

First frontal convolution: The pia is thickened and hyperplasia of the connective tissue elements visible.

The greatest alteration in degree and number of ganglion-cells is found in the medium and large-sized pyramids of the ganglionic layer. The small pyramids contain much pigment, and many of them are stained unusually darkly. Some of them show central chromatolytic

changes. The nuclei are often elongated, deformed, and occupy an eccentric position. Vacuolar degeneration is present in some instances. Other cells are shrunken and their processes appear separated from the cell body. The large pyramidal cells show similar changes, but to a less degree than the small cells. Cleavage and granular degeneration of the neurofibrils is apparent in the majority of the small cells, but in most of the large pyramids the neurofibrils remain intact.

The membrana glia superficialis is somewhat thickened. A degeneration of the tangential fibres and the supraradiary plexus can be discerned. The radial fibres, however, are but slightly affected.

A marked increase of the glia elements and fibres is visible. The alterations in the glia-cells are analogous to, but somewhat less pronounced than those in the cells of the precentral area. Here also the small type of glia-cells predominates, but cells with large pale nuclei and metachromatically stained nucleoli present a conspicuous feature of the microscopic picture. The walls of some of the vessels are thickened, and their cellular elements shrunken and darkly stained. The adventitial spaces in many instances contain pigment.

Temporal region: The pathological changes in this area correspond to those found in the frontal convolutions, but are less severe in character.

Occipital region: Many of the ganglion-cells are well-preserved, while others are swollen and faintly stained; some are shrunken and darkly stained, and in many cells an abnormal increase of lipoid material is evident. A hyperplasia of the glia is present. The oblique and tangential fibres are somewhat reduced in numbers. The pia is but slightly thickened.

Hippocampal region: The marginal glia is thickened and contains many corpora amylocea. The ganglion-cells are considerably altered. The prevailing type of degeneration is sclerosis of the cells with increase of pigment.

Numerous large glia-cells are seen with thickened fibres, especially in the vicinity of blood-vessels. By Bielschowsky's method a granular fibrolysis is visible in some cells, but neither the fibrillar change of Alzheimer nor senile plaques are present.

The changes in the corpus striatum and optic thalamus are very great. The caudate nucleus appears less affected than the lenticulate nucleus and optic thalamus.

The degeneration of the ganglion-cells is striking, and in most of them degeneration is quite advanced. The pronounced increase of the

lipoid pigment is the most prominent feature of this degeneration; in fact, in some of the degenerated cells the cytoplasm is entirely filled with fat.

By Bielschowsky's method it is seen that the neurofibrils are no longer continuous through the cell body, but in many cells are broken up into fine particles. Changes in a few bundles of nerve-fibres in the lenticulate nucleus and optic thalamus occur.

Hyperplasia of the glia is prominent, especially is the small variety with darkly stained nuclei in evidence, and areas are frequently encountered where these cells are grouped together in large numbers. A perivascular gliosis is visible in many instances. A considerable thickening of the walls of many of the vessels is discernible. Amyloid bodies are unusually plentiful, and groups of ten to twenty are frequently seen.

Cerebellum: Alterations could be detected in a few only of the Purkinje cells. The glia-cells are increased, especially in the molecular layer, and the superficial basal membrane is thickened. No appreciable fibre decrease is perceptible with the Weigert-Pal or Bielschowsky methods.

Medulla oblongata: The cells of the motor nuclei show no obvious deviation from the normal. In some of them a granular degeneration of the neurofibrils is apparent.

Spinal cord: Most of the cells of the anterior horns appear smaller than normal, but otherwise show no distinct alteration in any region of the cord. In a few of them an increase of the lipoid pigment is perceptible. A number of the cells of the posterior and lateral horns in the cervical region show a more extensive alteration. In the thoracic region a few of the cells of Clarke's column show chromatolysis, and some cells of the posterior horns pigmentary degeneration. In the upper lumbar cord, a small hæmorrhage is present in the vicinity of, but not extending into the central canal. Numerous amyloid bodies are visible in the posterior columns in all parts of the cord. A slight increase of glia is perceptible. A study of longitudinal sections show only a few typically degenerated fibres.

Peripheral nerves and spinal ganglia: A careful examination of the radialis, ulnaris, medianus, ischiadicus, cutaneous femoris posterior and spinal ganglia, failed to reveal any pathological alterations.

Case 2.—G. S., white, male, private U.S. Marine Corps. Was admitted August 11, 1900, and died December 6, 1912. His father suffered from alcoholic insanity and his mother was of a neurotic temperament. Patient

was born in the State of Ohio in 1872. He began school at the age of 5 years and the childhood period of his life was uneventful. He enjoyed good physical health until the age of 20 years, when he had an attack of typhoid fever. The first choreiform movements were noticed at the age of 26. About July, 1900, he became hypochondriacal and gave evidence of persecutory ideas and irritability. Prior to that date no change in his disposition had been observed.

Upon admission to the hospital the patient appeared to be in fair physical health. Temperature and pulse were normal. Vision was good and the pupils reacted to light promptly and were equal and regular in outline. The skin and lymphatic glands were normal. The bones were large, but no anomalies or malformations were present. Examination of the internal organs failed to reveal any evidence of disease. The deep and superficial reflexes were exaggerated. No areas of tenderness; hearing and taste normal. Smell somewhat impaired. Urine: clear, acid; specific gravity 1025. No albumen, sugar or casts. Few leucocytes. Reaction time prolonged. Perceptions false. Memory poor. Reasoning and judgment impaired. Ideation is imperfect.

The emotional state was that of depression, hypochondriasis and a tendency at times towards hyperirritability. He was disposed occasionally to become violent in his attitude towards the patients and attendants.

When spoken to he failed to reply and walked away, or his replies were mumbling and incoherent. He was untidy with his clothing and personal appearance, and had difficulty in getting about. His head and hands were continually in motion, and owing to these irregular movements he generally required feeding. He usually manifested no interest in his surroundings, or gathered trash, with which he filled his pockets. He expectorated on his clothing, and when in bed picked at and destroyed the bed-clothing. The facial expression was constantly changing, frowning, winking, one side of the face was contracted, then the opposite angle of the mouth. The fingers, hands, arms, shoulders, knees, legs and neck muscles jerked, and the body was thrown from side to side.

A gradual mental and physical deterioration occurred, and the patient died December 6, 1912.

Post-mortem Record.

External examination.—Body was medium sized and well developed.

Internal examination.—Calvarium symmetrical, wall thickened in frontal and occipital regions, diploe compact. No roughening of inner surface. The dura mater was slightly thickened, smooth and not adherent to the skull cap or pia. The vessels of the pia were not prominent. The pia stripped readily, no opacity was present, and it appeared normal.

Brain: Weight 1,100 grm. Slight atrophy, but firm and of even

consistency. The basal vessels are clear. The ventricles are not dilated, and ependymitis is absent.

Spinal cord: Appeared unusually small in size.

Thorax: Pericardium normal. Heart, weight 1,100 grm. Right auricle enlarged, wall thin. Tricuspid valve normal. Right ventricle normal. Pulmonary valve and artery normal. Left auricle somewhat enlarged. Mitral valve normal. Left ventricular wall thickened. Aortic leaflets slightly thickened. Lungs, pleural adhesions present. Emphysema, œdema and congestion in evidence.

Abdomen: Liver, weight 1,230 grm. Surface smooth, capsule normal. Passive congestion. Gall-bladder normal. Spleen, weight 150 grm. Capsule thickened, surface smooth, pulp soft and red in colour. Pancreas, stomach and intestines normal.

Genito-urinary tract: Kidneys, weight, right 150 grm., left 170 grm. Right kidney surface smooth, capsule strips readily, cortex thickened. Left kidney same condition. Bladder, mucous membrane somewhat congested.

Microscopical Examination.

Precentral region: The pia is somewhat thickened and shows a hyperplasia of the connective tissue. No marked increase of cellular elements is visible.

Various alterations in the size, shape and staining reaction of many ganglion-cells throughout the cortex in this region is apparent. The Betz cells, however, for the most part appear quite normal. Some of these cells are swollen, their sides are rounded, giving them a circular aspect, others are small and shrivelled, the cytoplasm is broken and interrupted, and the nuclei are ill-defined. Many of the cells presented a faintness of staining, and in addition to this a homogeneous aspect, so that the cells present a uniform colour.

Chromatolytic changes are observed, and instead of the row-like appearance usually presented by the tigroid material, a fine dust is seen scattered irregularly throughout the cell, or the Nissl substance appears in long threads or is clumped. A deficiency or absence of chromophilic substance generally accompanies these changes. A considerable increase of pigment occurs in most of the cases. Changes are evident in the nuclei which show abnormalities in shape and appearance. Frequently eccentricity occurs. In some instances the nuclei are greatly enlarged, and in others but slight distension has occurred. The nucleoli are

occasionally unusually large and stain metachromatically. Numerous cells show a twisting of the apical processes of the cells, giving them a corkscrew-shaped aspect. The dendritic processes are atrophic and apparently broken off. Many of the cells show evidence of vacuolation, numerous vacuoles at times occurring in a cell.

Disintegration of the neurofibrils is visible in degenerate cells. The tangential and interradiary fibres are reduced.

The neuroglia cells are greatly increased, mostly in the lower layers of the cortex. Many of the glia-cells present gross pathological changes. The protoplasm appears coarsely granular. The nucleus is shrunken and excessively stained; the chromatin substance is markedly increased; the granules enlarged, collected around the periphery of the nuclear membrane, or massed together, practically occupying the entire nucleus, in which instance the nucleus appears as an homogeneous, intensely stained blue mass. An accumulation of yellow pigment is frequently present in the protoplasm. Glia-cells are also encountered, having an angular, or rod-like nuclei. The nuclei present a triangular, or shrunken, rod-like appearance, and the protoplasm of these cells is disposed as long delicate processes; other glia-cells are met with having greatly enlarged nuclei. The nuclear membrane is considerably thinned and the caryoplasm achromatic, a delicate net-like structure is seen uniting the chromatin particles, and one or two metachromatically staining nucleoli are in evidence. The cytoplasm of these cells is quite perceptible, staining a violet shade, and numerous delicate processes extend from the cell body. Lipoid granules are usually observed lying within the cell body.

Glia-cells having a typical rod-like form are frequently encountered lying in close proximity to, or apparently within the cytoplasm of the cell body, or processes of degenerated ganglion-cells.

With Alzheimer's methods for the staining of glia-cells, the cytoplasm of the hypertrophic glia-cells is intensely and extraordinarily stained. Some of their processes are seen to be in direct relation to the blood-vessels, especially the capillaries.

Aside from this a number of processes extend in various directions from the cell body, some of which are short and broad, while others are thin, long, and pursue a rather tortuous course.

Weigert's stain for glia shows a hyperplasia of the glia fibres and the presence of fibrinoid granules.

Many of the vessels are twisted and tortuous. This twisting of the vessels causes them to appear constricted in some parts of their course.

The intima of the capillaries is more darkly stained than normal.

The adventitial spaces contain considerable disintegration products. A thickening of the adventitial connective tissue is evident, and the protoplasm of the adventitial cells contains lipoid substance.

In the first and second frontal gyri a slight hyperplasia of the pia is evident.

The alterations in the cells in this region are chiefly shrinkage of the cell, which predominated in the neurones of the lower layers. The contour of the cell is shrunken and distorted, and retro-action of the borders of the cell body between the processes not infrequently occurs, causing the cell body to assume an elongated, rod-like aspect. A well-defined net-like structure is discernible in the cell body, and is usually visible in the processes. The nucleus is darkly and homogeneously stained, often reduced in size and distorted. The nucleolus is pale and frequently oval in shape. Many of the large ganglion-cells are not shrunken, but show a marked change in the distribution of the Nissl substance throughout the cell. The chromophilic substance is observed at the base and sides of the cell body, or forming a rim around the periphery of the pyramid. In some instances the rim is continuous, and in others it consists of a number of separate masses. In most of these neurones the basal processes are more altered than the apical processes. The nucleus is ill-defined and the nuclear membrane cannot be demonstrated. The neurofibrils are considerably altered in some cells and indistinct in others. Disintegration of the tangential fibres is present. Proliferation of the neuroglia cells occurs, especially in the deeper layers of the cortex. The pathological changes in the glia-cells resemble those found in the precentral region. Many of the vessels show a hyperplasia of the adventitial cells and a fatty degeneration of the endothelial elements.

The cellular alterations in the cortex of the temporal and occipital regions are similar to those seen in the frontal convolutions, although less extensive. The alterations affect principally the deeper layers, but abnormalities can be detected throughout the depth of the cortex. Reduction in the tangential fibres is equally intense. However, the most marked changes in the cerebral cortex are in the frontal gyri and precentral convolution.

In the hippocampal region sclerotic changes are visible in most of the ganglion-cells. The cell bodies are deeply stained and the nuclei deformed and angular. Some cells are swollen and their nuclei enlarged. Granular disintegration of the neurofibrils occurs in some

cells. Proliferation of the glia-cells is present, and slight thickening of the walls of many vessels.

The pathological changes in the optic thalamus are severe; somewhat less so in the caudate nucleus. The lenticulate nucleus is the most affected. The degeneration in the neurones is severe and extensive. A general chromatolysis is visible, and the majority of the cells shows an abnormal increase of lipoid substance. In others, sclerosis or shrinkage occurs, and numerous darkly stained coarse granules are perceptible in the cytoplasm and processes. The chromatin granules of the nuclei are increased in number, and vacuolar degeneration can be observed in some instances. The neurofibrils in many cells are seen to be discontinuous and appear as fine granules by the Bielschowsky method. The pronounced increase of the small non-fibre building glia-cells is striking. Large numbers of these cells are seen around and sometimes lying within the cytoplasm of ganglion-cells. A marked gliosis is seen in the vicinity of capillaries, the walls of which are thickened. The adventitial spaces of many of the vessels contain pigments; clusters of amyloid bodies are numerous.

Cerebellum: Some of the Purkinje cells show chromatolytic changes, and neurofibrillar disintegration is also apparent and in many cells.

Spinal cord: In the anterior horns only a few of the cells show slight alteration, but degenerative changes are more marked in the cells of the posterior horns throughout the cord. A number of amyloid bodies are present in the posterior columns. Only a few degenerated fibres are in evidence. No pathological changes can be detected in the spinal ganglia or peripheral nerves.

The anatomical findings in both cases were similar. Slight atrophy of the brain with increase of the spinal fluid, somewhat more marked, however, in the first case. Other than a moderate degree of thickening, the meninges appeared normal. Neither dilation of the paracœles or ependymitis of the lateral or fourth ventricle was present. The smallness in the size of the brain and spinal cord was a conspicuous feature in both cases.

Microscopically diffuse degenerative changes in the nerve-elements of the brain was evident. This degeneration was most severe in the optic thalamus, corpus striatum, the frontal and the pre- and post-central regions.

In reference to the medullated fibres of the cortex, a deficiency of the tangential fibres was especially noticeable, and the oblique fibres,

forming the interradiary and supraradiary plexuses were similiarly affected. The radial fibres composing the radiations of Meynert were well preserved.

The ganglion-cells showed different types of degeneration. While acute degeneration occurred in many of the cells, sclerotic changes were apparently more frequent. The great increase of lipoid pigment within the cells was a prominent feature of the microscopic picture.

The Betz cells, with the exception of a few, were remarkably well-preserved throughout.

The changes in the neuroglia tissue were an enormous increase of the glia-cells and glia-fibres, especially in the lower layers of the cortex, the corpora striata and thalami, the cells having small pycnotic darkly staining nuclei being the predominating type.

The most obvious pathological alterations in the vessels were found in the lenticulate nuclei and thalami. The walls of many of the capillaries were greatly thickened and their lumen sometimes nearly obliterated. An extraordinary number of amyloid bodies were present in the posterior columns of the spinal cord, the thalami and lenticulate nuclei, but were more numerous in the first case.

In reviewing the literature, it is obvious that the only agreement which exists among investigators is that an organic change in the brain occurs. It has been the opinion of some that a diffuse or circumscribed encephalitis, or meningo-encephalitis, constitutes the pathological basis of the disease (Greppin, Oppenheim, Weidenhammer), while others attributed it to vascular alterations (Wollenberg). It seems probable that the meningeal and encephalitic conditions found at autopsy represented terminal complications in the disease rather than the cause of the symptoms.

Most of the writers on this subject have reported the occurrence of an atrophic process in the central nervous system, especially of the cortex of the cerebrum. Some writers (Stier, Kattwinkel) found the motor region most affected; Oppenheim and Hoppe, the central convolution, the parietal and occipital lobes. Other cases showed no atrophy microscopically. The results of most investigators coincide as to the occurrence of severe cellular degeneration in the cortex. This degeneration has been described in some cases as uniform throughout the cortex, while in other instances it was more intense in certain layers. Menzies found a degeneration of the cells in all the layers, but especially the deeper ones. Besta describes an alteration of the cells in the upper

layers, although he considered this as secondary to a leptomeningitis. In the cases examined by Daddi, degeneration of the ganglion-cells occurred especially in the frontal and motor regions. Clarke found the pyramidal cells especially in the superficial layers of the central and frontal areas affected. Stier discovered a chronic degeneration of the small and medium-sized ganglion-cells of the second and third layers, and in Rusk's case, the medium-sized pyramidal cells showed the greatest variation from the normal. Kölpin found the cells of the outer granular layer, and the small pyramidal cells of the third layer degenerated to a greater extent than in the other layers. Modena observed that the large pyramidal cells of the cortex were slightly affected only, but pronounced chromatolysis and eccentricity of the nucleus prevailed in most of the small ones. Facklam, however, asserts that the small and large pyramidal cells were normal in a case examined by him. Many authors failed to detect any, or only a slight, pathological modification of the Betz cells (Stier, Greppin, Raecke, Kölpin, Rusk).

A number of writers have regarded hyperplasia of the glia as the characteristic alteration.

Collins found the glia increased, especially in the deeper layer, around the pyramidal cells and vessels. Clarke reports an increase in the amount of interstitial tissue and the number of neuroglia cells in the second and third layers; Menzies a slight coarseness of neuroglia in the first layer; Weidenhammer a hyperplasia of glia chiefly in the deeper layers; Schulz in the glia-cells, especially in the layer of large pyramids. Berkley found an increase of neuroglia in the medulla and spinal cord. Stier describes an increase of glia, and believes that, owing to an inherited anomaly of the motor cortex, the glia begin to proliferate in this region, especially in the layer of small and medium-sized ganglion-cells. He considers this proliferation as a primary process and the atrophy as secondary. Some writers, however, observed no increase of cellular elements in the cortex (Facklam). Kölpin found the marginal neuroglia somewhat thickened, but no marked increase of the glia elements was demonstrable.

Lannois and Paviot, Modena, and other investigators, especially in recent years, have observed, in addition to cortical degenerative changes, more or less severe alteration in the basal ganglia.

Margulies describes a hyperplasia of the glia and degeneration of the cells of the cortex and basal ganglia with atrophy of the tangential and supraradiary fibres. He is of the opinion that the muscular spasm is caused by irritation, which the proliferating glia exercise upon the

nerve elements. From our present knowledge, however, of the rôle played by the glia in pathological processes, this hypothesis seems improbable.

In three cases examined by Alzheimer he found the most severe changes in the corpus striatum. Also in the subthalamic region the cells were greatly degenerated, somewhat less in the thalamus, pons, medulla, and spinal cord.

Morphological deviation in the architectonic of the cortex has been advanced as a possible etiological factor. However, if this were the case, it seems probable that evidence of the disease would be manifest from birth, whereas the symptoms do not occur until late in life and always assume a progressive character.

In conclusion, it may be stated that the pathology of chronic degenerative chorea consists not only in a degenerative process in the nervous elements of the cortex, but of the thalamus and corpus striatum.

BIBLIOGRAPHY.

[1] Alzheimer. *Zeitschr. f. d. ges. Neurol. u. Psychiat.*, 1911, Bd. iii, Ref. S. 566.
[2] Berkley. *Medical News*, Philadelphia, 1883, vol. xliii, p. 200.
[3] Clarke. *Brain*, 1897, vol. xx, p. 22.
[4] Collins. *Amer. Journ. Med. Sciences*, 1898, vol. cxvi, p. 275.
[5] Facklam. *Arch. f. Psychiat.*, 1898, Bd. xxx, S. 137.
[6] Greppin. *Ibid.*, 1892, Bd. xxiv, S. 155.
[7] Kattwinkel. *Deut. Arch. f. klin. Med.*, 1899, Bd. lxvi, S. 517.
[8] Kölpin. *Journ. f. Psychol. u. Neurol.*, 1909, Bd. xii, S. 57.
[9] Lannois and Paviot. "Neurographs," 1908, vol. i, p. 105.
[10] Margulies. *Korsakoffsches Journ. f. Neuropath. u. Psych.*, 1910.
[11] Menzies. *Journ. of Ment. Science*, 1892, vol. xxxviii, p. 560; *ibid.*, 1893, vol. xxxix, p. 50.
[12] Modena. *Annuario del Manicomio prov. di Ancona*, 1905, anno iii, p. 55.
[13] Monnier, P. *Thèse de Paris*, 1911.
[14] Oppenheim und Hoppe. *Arch. f. Psychiat.*, 1893, Bd. xxv, S. 617.
[15] Raecke. *Ibid.*, 1910, Bd. xlvi, S. 727.
[16] Rusk. *Amer. Journ. of Insanity*, 1902-03, vol. lix, p. 63.
[17] Schulz. *Charité-Annalen*, 1908, Bd. xxxii, S. 189.
[18] Stier. *Arch. f. Psychiat.*, 1903, Bd. xxxvii, S. 62.
[19] Weidenhammer. *Neurol. Centralbl.*, 1910, Bd. xx, S. 1161.
[20] Wollenberg. *Nothnagel's Spec. Pathol. u. Therapie*, 1899, Bd. xii, Teil 2, Abth. 3.

EXPLANATION OF PLATE.

FIG. 1.—Degenerated ganglion-cell from the precental gyrus. Toluidin blue. Zeiss Imm. $\frac{1}{12}$ oc. 3. The cell-bodies of the surrounding glia elements are filled with yellow pigment, and one of them is seen lying within the cytoplasm of the nerve cell.

FIG. 2.—Distorted pyramidal cell with eccentric nucleus, from the frontal region. Toluidin blue. Zeiss Imm. $\frac{1}{12}$ oc.

FIG. 3.—Nerve cell of the third cortical layer, frontal region. Toluidin blue. Zeiss Imm. $\frac{1}{12}$ oc. Much shrinking has occurred.

FIG. 4.—Contiguous degenerated ganglion-cells in paracentral region. Many glia-cells are seen in the vicinity of their base. Toluidin blue. Zeiss Imm. $\frac{1}{12}$ oc. 3.

FIG. 5.—Pyramidal cell from the anterior central convolution showing fine granular degeneration. Toluidin blue. Zeiss Imm. $\frac{1}{12}$ oc.

FIG. 6.—Ganglion-cell from paracentral region showing vacuolar degeneration. Toluidin blue. Zeiss Imm. $\frac{1}{12}$ oc.

FIG. 7.—Nerve cell from lenticulate nucleus showing extreme fatty degeneration.

FIG. 1.

FIG. 2.

FIG. 3.

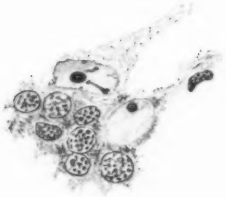

FIG. 4.

FIG. 5.

FIG. 6.

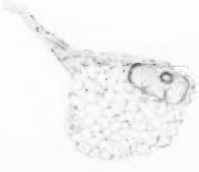

FIG. 7.

To illustrate "A Contribution to the Pathology of Chronic Progressive Chorea."
By J. A. F. PFEIFFER, M.D.

Sale & Dunnidge, Ltd., Lith.

A CASE OF LANDRY'S PARALYSIS WITH ESPECIAL REFERENCE TO THE ANATOMICAL CHANGES.

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More than half a century has passed since the description by Landry, in 1859, of an increasing progressive form of paralysis, affecting the muscles of the legs and rapidly extending in turn to the arms and trunk, and producing death by paralysis of the muscles of respiration. The reflexes are lost, but the muscles retain a normal reaction to faradism. Muscular and special senses are not involved, and the sphincters remain intact. Slight fever, numbness and tingling in the fingers may be present. In Landry's case, no lesions were found in the brain or spinal cord at autopsy. To this affliction the name Landry's paralysis has been ascribed.

Since then a copious literature has accumulated, and numerous cases have been reported, simulating clinically to a greater or less extent in semiological features Landry's description.

From an etiological point of view, it is generally supposed that the affliction has a toxic basis. Bacteria have been discovered in a number of instances (Eisenlohr, Remlinger, Marie and Marinesco), and some investigators have attempted to isolate a specific organism (Nazari, Buzzard).

The first anatomical examination of Landry gave a negative result, and he postulated that the condition was without an anatomical foundation. In the older literature a number of cases are on record which were subjected to *post-mortem* examination and in which no lesions were found.

The explanation for the negative pathological findings in the older cases is obvious when we consider the fact that these examinations were made before the introduction of selective and improved methods for the staining of nervous tissue, especially the peripheral nerves. In

addition to this the histological examinations were in several instances quite incomplete; even in the later literature many cases are recorded in which an examination of the peripheral nerves was not made.

In such instances it is plain that no definite conclusions could be deducted in reference to the morbid pathology.

If we consider the abundance of cases which have been reported in recent years, in which a complete pathological examination has been undertaken with improved methods, it becomes apparent that morbid changes can scarcely be regarded as negative in this type of paralysis.

It has, therefore, been the desire of investigators to establish some relation between the clinical manifestations and the pathological changes, and to discover the etiological factors in the production of the clinical picture. The question then arose whether the symptoms were due to changes in the peripheral or central nervous system. But the difficulty which has presented itself is the lack of uniformity and the variation in the descriptions of the pathological alterations.

Changes have been described in the cells of the anterior and posterior horns of the spinal cord, especially the anterior horns, with myelin degeneration in the central nervous system as well as the peripheral nerves. Degenerative changes have been reported in the anterior and posterior roots. Probably the most frequently described morbid condition has been a hyperæmia of both the spinal cord and meninges, associated with capillary hæmorrhages or perivascular infiltration. An intense diffuse inflammation of the spinal cord and meninges has been observed, accompanied by marked vascular infiltration and areas of softening. Changes confined exclusively to the peripheral nerves have been reported, and hyaline degeneration of the walls of the blood-vessels.

The numerous instances in which enlargement of the spleen and pleurisy with recent or old adhesions has been observed, is interesting.

Great importance has been attached to the changes in the spinal cord and brain, and consensus of opinion has been that the anatomical alterations in this condition are to be found in the central nervous system.

A number of authors have called attention to the possibility that the affection is essentially polyneuritic in character, and not dependent upon changes in the central nervous system. Dydynskí has placed great importance upon the damage to the peripheral nerves, but believes that the central nervous system may also to a greater or less extent be involved. He explained the cause of the ascending character of the

paralysis by the theory that the most important nerves possess the greatest resistance against toxins and are in consequence the last to become affected. Rolly, in a report of seven cases of Landry's paralysis, concluded that it was an acute type of polyneuritis. In one of his cases the changes were confined to the fine muscular branches. He laid great stress upon the examination of the peripheral nerves in all cases of acute ascending paralysis.

V. Leyden and Goldscheider concluded from the manifold anatomical changes, that the affection could assume a bulbar, medullar or neuritic form. They believed that a combination of any two of these conditions could occur and might begin in the peripheral nerves and ascend to the spinal cord. Saltmann suggests a separation of the condition into several forms depending on polyneuritis, myelitis, or without anatomical changes. Such a division might indicate different stages of the same process, depending upon the duration of the disease and the virulence of the toxin. Other authors believe that a close relation exists between poliomyelitis and the Landry symptom-complex. Wickmann states that the most of the fatal cases of acute poliomyelitis in the final stages of the disease present the symptoms of an acute ascending or descending paralysis. Harbitz and Scheel declare that many cases of so-called Landry's paralysis, or ascending paralysis, are severe cases of acute poliomyelitis, with the usual extension outside of the spinal cord. Mosny and Moutier believe that the Landry's symptom-complex corresponds anatomically to an encephalomyeloneuritis, or toxic infection of the entire neurons.

According to other authors, Landry's paralysis is only a clinical "symptom-complex" which may occur in diseases affecting different parts of the nervous system, viz., poliomyelitis, lyssa, polyneuritis, &c.

In view of the diversity of opinions in reference to this affection, a report of the following case seems appropriate, since it presented some interesting features, and inasmuch as a pathological examination with the latest methods was possible.

History of Illness.

Case 395.—Male, aged 24. German, stove fitter, single.

Family history.—Mother dead. Father living and healthy. Patient had nine brothers and sisters; six died in infancy; those living are healthy. No history of nervous or tubercular disease in the family.

Personal history.—Patient learned to walk between the second and third year of age. Successful with his studies at school. From 1908 to 1910 he

served as a soldier in the German Army. He was not a heavy smoker and did not use alcohol to excess.

Past illnesses.—During childhood he had diphtheria and whooping cough. No history of eye or glandular diseases. The adult life of the patient was free from illness.

Present illness.—On the morning of January 4, 1912, the patient on rising observed that he had difficulty in walking. He did not recall having noticed any weakness in his lower extremities the day before. He suffered no pain whatever, but his legs felt heavy, and walking was so uncertain that, contrary to his usual custom, he used the street car in going to work. During the day he felt languid and faint. He could not sleep at night and was more comfortable when lying upon his back. On the morning of January 5 his condition was about the same, and he went to his work, but was compelled to return home about noon on account of the increasing weakness in his legs, and a few hours later could not stand without support. His appetite was extremely poor. No fever was noticed. His physician ordered him to bed.

On January 6 the paralysis was more marked and the patient uncomfortable and restless.

January 7: His physician ordered him to be sent immediately to the hospital. The paralysis extended to the upper extremities, being more pronounced in the left arm than the right arm.

January 8: Paralysis of the arms was complete, but no pain was felt by the patient, only discomfort from lying on his back. He suffered somewhat from headache, and a coated tongue.

January 9: Patient was very weak, but no new symptoms developed.

On the morning of January 10, the patient experienced difficulty in swallowing and was extremely weak. The paralysis extended to the muscles of the shoulders and neck, and difficulty in speaking supervened. About 4 p.m. he complained of dyspnœa and breathing became laboured. At 6.30 death occurred from respiratory paralysis.

Physical Examination.

The following examination of the patient was made on his admission to the hospital, January 7, 1912. Patient a young man of pale complexion and appeared to be well nourished. Muscles well developed. No excess of fat. Œdema, exanthema or scars absent.

Head: Eyes, nose, and ears normal.

Mouth: Tongue coated, teeth in fair condition. Pharynx and tonsils swollen and congested.

Neck: Normal.

Thorax: Normal in breadth. Somewhat flat. Expansion normal.

Lungs: Vesicular breathing. No rhonchi or other abnormal signs.

Heart: Action regular. Sounds intensified. Pulse regular and full.

Abdomen: Not sensitive to pressure. Liver and spleen could not be palpated.

Spinal column: No deformity present; not sensitive to pressure.

Urine analysis: The urine was regularly examined, but nothing pathological could be detected.

Examination of the spinal fluid: Colour normal. Three cells per cubic millimetre.

Wassermann test: With both blood and cerebrospinal fluid negative.

Neurological Examination.

Sight: Pupils react normally to light. Acuteness of vision $\frac{6}{6}$. No strabismus. Conjunctival reflex normal.

Hearing: Auditory apparatus in good condition (Weber and Rinne tests).

Smell: Normal.

Taste: Normal.

Upper extremities: The patient could raise his right arm with great effort only, and his left not more than 45°. Muscles very weak—left more so than the right. Dynamometer 10. Flexors and extensors similarly affected. Muscular atrophy absent.

Reflexes: Triceps—left less than right. Biceps—left less than right. Abdominal and cremasteric reflexes normal.

No pain upon pressure or other sensory disturbances could be elicited. Ataxia absent.

Lower extremities: Active movement impossible. No muscular atrophy.

Reflexes: Patellar and achilles lost. No sensory disturbances. Rectal and vesical sphincters intact.

Autopsy.

Body medium sized, well nourished and muscular. No œdema or scars were found.

Thorax: Upon opening the thorax the lungs sunk but slightly backward, and were adherent to the anterior wall of the thorax. The pleura was greatly thickened.

Lungs: Weight 1,190 grm. The upper lobe of left lung was soft in consistency. The lower lobe somewhat firm. Upon section the upper lobe was found to be emphysematous and considerably congested. The surface of the section was of dark grey colour. Upon pressure a thick grey secretion could be expelled from the bronchi and parenchyma. The mucous membrane of the bronchi was swollen and slightly congested. The upper and middle lobes of the right lung were soft in consistency, also the lower lobe in its peripheral portions. Upon section the upper and middle lobes were found to contain air.

In the firm portion of the inferior lobe several small pneumonic areas of consolidation were present.

Pericardium: A few drops of clear yellow fluid were present in the pericardial sac.

Heart: The heart was about the size of the fist of the corpse. Anteriorly the pericardial fat was greatly increased. The wall of the right ventricle was 0·7 cm. thick. The mitral cusps were thin and smooth. The endocardium was soft and glossy. Upon the epicardium of the left ventricle groups of blood clots were present. The wall of the left ventricle was 1½ cm. thick. The endocardium of the left ventricle was rough. The mitral valve was somewhat thickened, also the aortic leaflets. The intima at the beginning of the aorta was smooth. The aorta was quite elastic. Upon section of the heart, muscle was a dark reddish-brown colour.

Mouth, œsophagus, &c.: The mucous membrane of the floor of the mouth and cheeks was injected and the tonsils much enlarged. The crypts of the tonsils contained yellow soft masses. The glands at the roots of the tongue were hyperplastic. Upon section the tonsil was of a reddish-grey colour. A small area about the size of a pea and of a greenish-grey colour was found in the right tonsil. The mucous membrane of the œsophagus was pale and smooth. The thyroid gland appeared normal.

Abdomen: Upon opening the abdomen, fibrous adhesions were found between the diaphragm, liver, and peritoneum.

Stomach: The mucous membrane was greyish-red in colour and contained petechial hæmorrhages.

Intestines: The mucous membrane of the duodenum somewhat thickened at the pyloric end. Here and there in the small intestines isolated areas of irregular mucous membrane were found. Otherwise normal in appearance. The lymph follicles were not enlarged. Peyer's patches appear normal. A thick secretion covered the lower portion of the large intestines. The mesenteric glands were somewhat enlarged.

Liver: Weight, 2,200 grm. The liver was firmly adherent to the diaphragm on the right side. Upon section it was found that small yellowish spots were scattered throughout the organ. Considerable congestion was present. The gall-bladder contained several dark orange coloured gall-stones.

Spleen: Weight, 500 grm. Enlarged. Adherent to the neighbouring organs by thick bands. The capsule was thickened, consistency soft. Upon section the pulp was dark red in colour and congested, and

the cut surface covered with a thick dark reddish-grey fluid. The follicles were quite evident.

Pancreas: Soft in consistency and of greyish colour. Between the spinal column and the pancreas many enlarged lymph glands of a yellowish-grey colour were present.

Suprarenal glands: Normal in appearance.

Kidneys: Weight, 320 grm. Firm in consistency. Capsule strips readily. The surface was reddish in colour. Upon section the parenchyma appeared of a bluish-red colour. The cortices were thickened. The pelves and calices congested and filled with a thick greyish-yellow secretion.

Bladder: Normal.

The muscles of the thorax and abdomen were unusually dry.

Head.—Calvarium: Symmetrical. Wall, 6 mm. in thickness. Diploe porous.

Dura mater: Tense, smooth, and unusually moist throughout.

Pia mater: Somewhat thickened in the frontal region of the left hemisphere, glossy and tender over the entire surface of the brain.

Brain: Macroscopically nothing pathological could be found.

Spinal cord: Upon opening the spinal canal some fresh coagulated blood was found in the lower portion. Otherwise the spinal cord appeared normal.

Bacteriologial Examination.

Cultures were made from the spleen and a streptococcus isolated.

Anatomical Diagnosis.

Consolidated areas in inferior lobe of left lung, Abscess of the pharyngeal tonsils. Pleuritic and peritoneal adhesions. Spleen greatly enlarged (septic splenic tumour). Congestion of kidneys.

Microscopical Study.

Various parts of the central nervous system and the peripheral nerves were fixed in different fluids; namely, formol, alcohol, Weigert's mordant and Orth's fluid.

The parts of the nerves were labelled by spreading them out upon strips of cardboard, to which they tenaciously clung.

The following staining methods were used: Nissl toluidin blue; polychrome methylene blue; Mallory's hæmatoxylin; Marchi; Bielschowsky; Sudan III; Van Gieson's hæmatoxylin-eosin; Weigert's myelin-sheath, &c.

Meninges: No infiltration or pathological changes could be found.

Brain: Sections from different parts of the brain were studied by the Nissl toluidin blue, Bielschowsky and other methods of staining, and the changes which occurred in the cells, the neuroglia, and the vessels will be considered.

An examination of sections from the paracentral lobe reveals the fact that the giant cells of Betz are well preserved and contain well-defined tigroid masses in more or less row-like arrangement in the cell body and dendrites.

A variable amount of change in some of the pyramidal cells, other than the Betz cells, is present, largely confined, however, to the pyramidal cells of the ganglionic and multiform layers of the cortex. The tigroid bodies have undergone disintegration. In some instances a general chromatolysis has occurred, but in many cases the bodies in the interior part of the cells are affected more than those peripherally placed, i.e., a central chromatolysis is present. In the cells in which a general chromatolysis has occurred, a row of small irregularly defined and disintegrated bodies can usually be seen around the periphery of the cell, while here and there cells in which the chromophilic bodies have vanished, can be found. Lying among the disintegrated tigroid bodies, granules of various sizes and shape can be seen. Sometimes large irregular masses occur, and often small bodies grouped together are encountered. In some instances the disintegration is of such a character that extremely fine granulations are present. The nuclei also present deviations from the normal appearance. The nucleus is in some instances swollen, and the nucleoli are not stained. Shrunken nuclei and nuclei with an eccentric position or displacement to the periphery of the cell are seen.

A study of the cell pigment (lipoid material) which forms an important element of the ganglion-cells, shows no increase in this substance. The quantity of this pigment normally varies considerably in different cells. The large pyramidal cells of the cortex and the cells of the anterior horn of the spinal cord normally show a regular amount of this substance, while others, as the granular cells and small pyramids, contain very little pigment. This pigment increases with age. In youth it is small in amount, while in old age it frequently fills a great part of the cell body. Care is necessary in the study of this lipoid substance when stained only by the Nissl method, as it usually appears as an almost clear and minutely subdivided area in the body of the cell, and at first sight might lead one to think that an extreme form of vacuolization of

the nerve-cell had occurred. Also in those instances in which the tigroid bodies are intensely stained, equal amount of the substance may appear quite different, according as the tigroid present is abundant or scanty.

With the Bielschowsky method for the study of neurofibrils, no change in these elements can be detected in most of the cells.

A hyperplasia of neuroglia-cells can be observed in the neighbourhood of degenerated ganglion-cells, and here and there glia rasen are in evidence. No vascular changes present.

Cerebellum: No pathological changes can be detected.

Medulla oblongata: The cells of the motor nuclei and of the formatio reticularis retain a normal appearance. A few of the cells of the nucleus gracilis, and of the nucleus cuneatus, show changes similar to those occurring in the cells of the lower layers of the cortex —that is, swelling of the chromophilic bodies, granular disintegration, shrinking and displacement of the nuclei. No degenerative changes or falling out of fibres could be found.

Spinal cord: Numerous sections from the cervical, dorsal, and lumbar regions of the spinal cord were prepared by methods for the study of pathological changes in the cellular elements, and alterations in the axis cylinders and medullary sheaths.

In the cervical region of the spinal cord the motor cells of the anterior horn show no alteration. The tigroid corpuscles are well defined, and retain their more or less characteristic row-like disposition in the cell body and dendrites. The nuclei are centrally situated, and no pathological changes can be seen. No abnormal increase in pigment is present. Some of the cells of the lateral horns, however, are swollen and show chromatolytic changes; the typical row-like arrangements of the Nissl bodies is lost, and they have undergone granular disintegration. The tigrolysis seems to be of a central type in most of the cells which show changes. The nuclei of some cells stain diffusely blue by the Nissl method, while other nuclei are swollen and refuse to take the blue stain. Occasionally slight fragmentation can be observed. The nucleoli present no marked alteration. In the posterior horns a few cells are found which show changes similar to those which occurred in some of the cells of the lateral horns.

In the thoracic region the cells of the anterior horns are likewise remarkably well preserved. Here and there a cell is encountered in which a row-like disposition of the tigroid corpuscles is disturbed, but otherwise no alterations can be seen. Slight granular disintegration in a few of the cells of the nucleus dorsalis is evident.

The motor cells of the anterior horns in the lumbar region present a normal appearance. A few of the cells in the posterior horns show changes of a similar character to those which have been described as occurring in the lateral horns of the cervical cord.

A painstaking examination of numerous longitudinal and cross sections from the cervical, dorsal, and lumbar cord revealed no degenerated nerve fibres.

Spinal nerve roots: In Nissl preparations an increase in cells appeared to exist in many of the roots. By larger magnification it is seen that this increase of cellular elements is due to the presence of polyblasts and "gitter" cells.

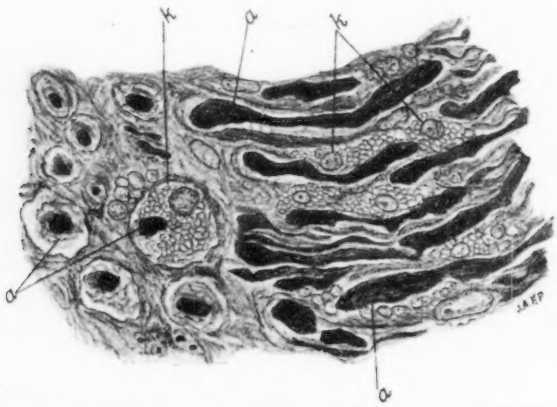

FIG. 1.—Bielschowsky method. Zeiss homo. Imm. $\frac{1}{16}$ oc. 1. From the crural nerve. Showing "körnchen" cells within the sheath of Schwann. *k*, "körnchen" cell; *a*, axis cylinder.

These changes are evident in the different roots and in the cauda equina, and are quite identical with those occurring in the peripheral nerves. The infiltration in the roots ceases somewhat before the point of their exit through the pia.

Peripheral nerves: For the study of the peripheral nerves the staining methods for the demonstration of the cellular elements, the medullary sheath and axis cylinder were applied. At the outset it could be readily noted that the changes in the brachial plexus and nervus cruralis were more marked than in the tibialis and peroneus. When sections were made with the microtome, numerous round and long areas of a greyish colour could be observed. By a low magnifica-

tion it is evident that the changes in the nerves are quite irregular, some bundles being intensely infiltrated, while others remain apparently unaffected.

The polychrome methylene blue stain was applied for the study of the elements of the nerves, since they, especially of the perineurium and endoneurium, take an important part in pathological processes in the peripheral nerves. A study of the epineurium shows it to be much infiltrated with polyblasts and "körnchenzellen." In some areas the infiltration is more pronounced than in others, and lymphocytes, polyblasts, and "gitter" cells are crowded together so closely as

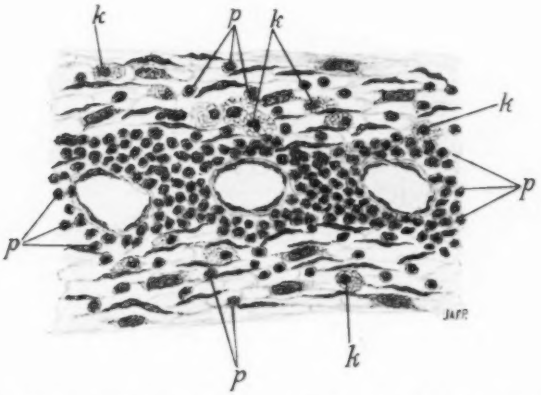

FIG. 2.—Polychrome methylene blue stain. Leitz obj. 6, oc. 1. From the peroneus nerve. Showing perivascular infiltration with "körnchen" cells and polyblasts. *k*, "körnchen" cell; *p*, polyblast.

to almost exclude other structures from view. Especially is this noticeable in the region of blood-vessels. Many "mast" cells are seen lying between the fat cells, in some instances collected together in masses. Large cells with horse-shoe shaped nuclei are occasionally encountered. Proliferation of the cellular elements is present.

The infiltration of the perineurium is even more pronounced. Here, as in the epineurium the polyblasts are prominent, and various stages of their development into "körnchenzellen" is in many areas beautifully illustrated. A proliferation of the cellular elements can be observed, their protoplasmic processes are more deeply stained and can be often traced for a considerable distance. "Körnchenzellen" are frequently seen in close proximity to these cells, to which they are applied. In

the endoneurium, polyblasts and "körnchenzellen" are encountered in large numbers lying between lamellæ, and in the perineural lymph space. Proliferation of the endothelial and fixed connective tissue cells is quite evident. In cross section the protoplasmic processes of the profilerated fixed connective tissue cells can be seen surrounding several nerve fibres. The Schwann cells are only slightly proliferated. The similarity existing between the Schwann cells and fixed connective tissue cells often makes it difficult to distinguish the former from the latter; in fact, at times they cannot be differentiated.

With the Marchi method, an increase of the Elzholz bodies between the myelin-sheath and the sheath of Schwann can be seen. In Marchi preparations which have been counter-stained with safranine, these bodies are more evident, and the neurokeratin net, in reference to the existence of which much discussion has occurred in the past, is brought out prominently.

By Van Gieson's stain—besides the intensely red stained connective tissue—the cellular elements are also beautifully stained. The darkly stained nuclei of the polyblasts and "körnchenzellen" are especially pronounced, and the net-like protoplasm of the "körnchenzellen" is quite discernible.

By the Sudan III method, the "körnchenzellen" are seen to be filled with yellowish stained lipoid material.

An examination of numerous preparations by the Bielschowsky method show the axis cylinders to be uninterrupted in their course, and presenting a normal aspect. Whilst occasionally a slight fragmentary degeneration in a fibre, or here and there a newly-formed axis cylinder process, or considerable irregularity in the size of a fibre can be found; as similar changes have been frequently observed in normal nerve fibres, they cannot be considered as pathological. The polyblasts and "körnchenzellen" are remarkably well stained by this method, and the pronounced infiltration quite perceptible. Although the axis cylinders appear themselves intact, a careful examination reveals the interesting fact that the medullary sheath has become invaded by "gitter" cells, which in cross section of the fibres, can be seen lying within the sheath of Schwann.

Conclusions.

The changes in the peripheral nerves on microscopical examination, are most interesting, and emphasize the importance of an examination of the peripheral nerves in all cases of acute spreading paralysis, as

it seems most probable that the pathology of this condition *per se* is to be looked for in the peripheral nervous system.

In this case the pathological findings are those of an interstitial neuritis, affecting the nerve roots and peripheral nerve stems.

It is also interesting to notice that in spite of the existence of this interstitial neuritis, no sensory symptoms or pain on pressure occurred.

The motor cells were well preserved through the central nervous system, and the cellular changes which were present could hardly be regarded as having any direct relation to the paralysis, as such cellular alterations are frequently found in other conditions not associated with acute spreading paralysis.

BIBLIOGRAPHY.

[1] Buzzard. *Brain*, 1903, vol. xxvi, p. 94.
[2] Dydynskí. *Neurol. Centralbl.*, 1904, Bd. xxiii, S. 128.
[3] Eisenlohr. *Deutsch. med. Wochenschr.*, 1890, Bd. xvi, S. 841.
[4] Harbitz und Scheel. "Pathologisch-anatomische Untersuchungen über akute Poliomyelitis und verwandte Krankheiten von den Epidemien in Norwegen, 1903-1906," Christiania, 1907; also *Journ. Amer. Med. Assoc.*, 1907, vol. xlix, p. 1420.
[5] Landry. *Gaz. hebdom. de Méd. et de Chir.*, 1859, t. vi, pp. 472, 486.
[6] Leyden und Goldscheider. *Nothnagel's Spec. Pathol. u. Therapie.*, 1895, Bd. x.
[7] Marie et Marinesco. *Revue des Sciences méd.*, 1896, t. xlvii, p. 134.
[8] Mosny et Moutier. *Arch. de Méd. expériment.*, 1911, t. xxiii, p. 284.
[9] Nazari. *Il Policlinico*, 1904, *Sez. Med.*, vol. xi, p. 337.
[10] Remlinger. *La Méd. moderne*, 1896, t. vii, p. 209.
[11] Rolly. *Münch. med. Wochenschr.*, 1903, Bd. l, S. 1283.
[12] Soltmann. *Jahrb. für Kinderheilk.*, 1900, Bd. li, S. 67.
[13] Wickman. "Beiträge zur Kenntnis der Heine-Medinschen Krankheit," Berlin, 1907.

DUCTLESS GLANDS AND THE NERVOUS SYSTEM.

The Pituitary Body and its Disorders. By HARVEY CUSHING, M.D. Philadelphia: J. P. Lippincott Co., 1912.

The Internal Secretory Organs. By Professor ARTUR BIEDL, of Vienna. English Translation by LINDA FORSTER, and Preface by LEONARD WILLIAMS, M.D. London: John Bale, Sons and Danielsson, 1912.

Innere Sekretion, ihre physiologischen Grundlagen und ihre Bedeutung für die Pathologie. Von Professor ARTUR BIEDL. Zweite neubearbeitete Auflage mit 131 Textfiguren und 20 mehrfarbigen Abbildungen auf 8 Tafeln. Berlin und Wien: Urban und Schwarzenberg, 1913.

DUCTLESS glands are in the present day theory of medicine as vaccines in its practice. There is little honest knowledge of either, yet all features of health and disease may be lightly ascribed to the one, and every ailment finds its golden hope of cure by injections of the other.

The books discussed in these pages will do much to dislodge confusion and ignorance, for they give a fair statement of what is known of the ductless glands, and they are written by men who rank among the chief authorities living on the subjects with which they deal. Cushing has modelled his treatise in the form adopted by Pierre Marie, Addison, and the great writers of the past, a separate account of each of a series of clinical cases being supplemented by the author's personal interpretation of the phenomena, so far as that can be based upon physiological experiment and pathological analysis. It is a clear record of fact, and while the evidence is marshalled to lead to definite conclusions, yet it is so displayed that criticism can at once disentangle the proved from the supposed and stop short, if it cares, of agreement with the final judgment. Original work has the advantage of this directness and simplicity, for it gives the outlook of a single mind.

Biedl attempts a more spacious task. Writing from the physiological point of view and not as Cushing, alert for every point that may tell in the diagnosis and treatment of clinical disease, he assembles all the observations that have ever been made on the ductless glands, in comparative anatomy, in chemistry, pathology, and especially in the

laboratories of experimental physiology. The host of papers so called up is nearly 4,000 strong, and its catalogue alone occupies more than 100 pages, a quarter of the entire book. But each in the multitude speaks as loudly as his fellow, and it is hard to pick out the main theme amid the babel of voices. In his desire to be disinterested and fair, Biedl has gone almost too far and produced rather an index catalogue than what one would have desired, a reasoned exposition of the views of the Viennese school, whose workers, with Biedl at their head, have explored every part of this wide field of labour. Worst of all is the extreme deference in the body of the book to that tedious custom which in physiology couples every observation with some man's name, as though it were a personal opinion that is quoted rather than a scientific demonstration of a fact. The result is as baffling as the walls of a railway station are to the traveller who, seeking to know where he is, hunts in vain for the name of the town amid the patchwork of advertisements. Time must establish a saner practice in this respect and teach the wisdom of what was written by Sir Thomas Brown in preface to Pseudodoxia Epidemica, "For Knowledge is made by Oblivion, and to purchase a clear and warrantable body of Truth, we must forget and part with much we know."

The English translation is somewhat unlucky in the time of its publication. Appearing at the close of 1912, though made from the first edition of the German text in 1910, it barely antedates Biedl's second edition. The latter is a great improvement on the first, printed in much pleasanter form, enlarged to two volumes and nearly twice its original size, and freely illustrated with reproductions from the chief papers in pathology, comparative anatomy, and physiology, so that the reader loses much by being confined to the English of the first translation. But the translator, Linda Forster, has done the work well. Slight mistakes catch the eye here and there. "Darmanhangsdrüse" (p. 13) are not the glands of the appendix, and despite the statement of p. 16 iodothyrin does not occur in the adrenals. "Autonomic" was the word employed by Langley to designate Gaskell's visceral nerves, and the translator brings this back again from the German into English with the needless change to "autonomous." Acquaintance with physiology would have saved this slip, which, like several others, shows ignorance of English terminology rather than difficulty with the German text.

A brief abstract of the main teaching of these two books may be of interest to readers of BRAIN, for the pathology of the ductless glands touches neurology closely at many points.

The Pituitary Gland.

Roughly, each decade has marked a great stride forward in the knowledge of this gland; 1889 brought the association of acromegaly with disease of the gland by Pierre Marie and Marinesco, the French clinician believing the main fault to be the loss of the secreting gland substance. In 1900 came the clinical recognition by Babinski and Fröhlich of the fatty eunuchoid condition, "dystrophia adiposo-genitalis," that may be related to an undoubted atrophy or destruction of the gland. In 1910 Cushing gave the Harvey Lecture which has been expanded into this present book.

Physiological experiments have in the meantime established the fact that from the posterior "nervous" part of the pituitary gland can be extracted an active principle which stimulates all plain muscle to contraction [10], the arteries of the lung as well as those of the systemic vessels (Dale [3]), and which excites some gland cells to prompt secretion, notably those of the kidney and mammary gland; but these observations at present have little value in the discussion of the clinical problem and their meaning is altogether obscure.

For the adrenal gland a law has been clearly proved that stimulation, whether it be of gland-cell or of muscle, by the active principle, adrenalin, can occur only in tissues innervated by sympathetic nerves, and that the reaction caused in them is almost the same as that to the nervous impulse. No such rule relating the action of pituitary extract applies to any part of the nervous system. At present, therefore, no guess can be hazarded as to why this substance is produced in the gland and excreted into the body; indeed, its stimulating property may be quite accidental to the gland extract, and in no way concerned with the true function of the cells.

The pituitary is an extremely complex mass of tissue. In front is the real glandular mass, the pars anterior, most richly vascularized, and containing at least two different types of cell, the one staining blue with hæmatoxylin and eosin and the other a distinctive red. It is not known whether the red eosinophile cell is morphologically and physiologically distinct from the blue (chromophobe), or whether it simply derives its colour from a special phase of secretory activity. Behind lies the pars nervosa, tissue of an indeterminate character, like neuroglia but with very few nucleated cells. The anterior crescentic mass envelopes the pars nervosa, and between the two is a cleft lined on either side by a deep glandular layer, the pars intermedia, which differs from the pars anterior in that its cells are not packed compactly one against the other

but resemble in their arrangement those of the thyroid gland, alveolar spaces being formed by distension with a colloid material.

The active principle, obtained by grinding with sand and boiling with saline solution, is yielded by the pars nervosa only. Eosinophile colloid material seems to be secreted in abundance from the true glandular cells, those of the pars anterior as well as those of the pars intermedia. Herring believes that the secretion passes, probably undergoing some change in the meantime, through the pars nervosa and thence by lymphatic clefts into the third cerebral ventricle and the system of the cerebrospinal fluid circulation [7]. This has not been fully proved to take place, whereas eosinophile colloid material can always be readily demonstrated in the rich capillary network of the glandular anterior part. Perhaps the colloid material is passed directly into the blood-stream; if such were the case the colloid would have nothing to do with the pars nervosa nor with the active principle obtained from the latter, of which alone the properties have been studied, and there would be no knowledge at all of the functions of the pars glandularis.

Cushing has recently endeavoured to show that the secretion from the pituitary is controlled by the cervical sympathetic nerve, but the experiments that he brings forward are of a very doubtful nature [2].

The clinical phenomena produced by disease of the gland are two-fold, those caused by direct pressure of its growth on neighbouring structures, such as the optic nerve, and those which are exhibited by the body generally as the result of too abundant or too scanty pituitary secretion. Symptoms of the second group, so far as is known, appear only in the slow changes of the form and growth of the body, whereby the normal type of manhood is perverted to the acromegalic giant or to a lethargic, eunuchoid creature overgrown with fat. This in itself is amazing enough, that a chemical secretion can slowly act with some mysterious power upon the texture of our bodies and alter its entire pattern.

But the pituitary has an abundant blood-supply, and its glandular cells pour out daily a considerable quantity of eosinophile material. Still greater must be the excretion of the thyroid from its larger bulk; while it has been proved by direct experiment that adrenalin is discharged into the blood from the medullary cells of the adrenal with almost every emotional and vasomotor reflex. Hence there may be other and speedier actions than those concerned in bodily growth. Other metabolic affairs are controlled by the secretions of the ductless glands; and from the pathological observations of the slow changes

wrought by glandular disease arises a fresh conception of physiological activity, that growth, metabolism, muscular tone, indeed much of the steady regulation of the life that burns within and gives us being, results from the daily interplay of these glandular secretions which each and all in their part restrain or accelerate the activities of the various tissues, and so maintain the normal type. This aspect of the question will be referred to again later in considering the meaning of pluriglandular insufficiency.

Cushing regards acromegaly as the index of excessive secretion by the pituitary; diminished secretion has its special clinical features of obesity with eunuchoid changes, and may be caused by adenomata or tumours destroying the pituitary directly. The same result may be caused indirectly as the result of pressure by cerebral growths. Acromegaly is then comparable with exophthalmic goitre, and the second condition with myxœdema.

In these glandular diseases affixes are needed with the noun to denote the state of plus or minus secretory activity. General use accepts hyper- and hypo-, although they are found to be difficult to distinguish from one another in speech, and in the case of the pituitary lead to a slight confusion with the hypophysis itself. There is need of a pair of words that shall be in sharper contrast one with another, and it therefore seems better to take the prepositions *super* and *sub*, which give the desired contrast.

Acromegaly is assumed by Cushing to indicate superpituitarism. The classical case of subpituitarism is that reported by Madelung, a girl aged 9 who was shot in the eye by a rifle bullet which lodged in the sella turcica. She failed to grow, and became exceedingly obese. Very similar is the result in young animals, according to Cushing (though this is denied by Horsley [8]), when the pituitary is experimentally damaged. He gives the following list of changes caused by subpituitarism in children or young adults: infantilism of the sexual organs, absence of pubic and axillary hairs, adiposity, especially of the subcutaneous fat, a dry skin, polyuria, depressed temperature, but a febrile rise of two or three degrees upon intramuscular injection of an extract of the anterior lobe of the pituitary gland, increased tolerance of carbohydrates, so that 200 or 300 grm. of glucose by the mouth do not cause glycosuria. In the adult these phenomena may occur independently (Fröhlich's type), or develop as the last stage of exhaustion in a gland which had in its earlier spendthrift excess produced acromegaly. Good results are said to have been obtained by feeding with pituitary gland

extract in these cases, though much larger doses are required than have generally been tried in England.[1]

Especially interesting is Cushing's account of adenomata of the pituitary. These benign growths are common in the adrenal, where they cause no symptoms; in the thyroid, where they may cause pressure on the trachea and become the seat of cystic or hæmorrhagic degeneration, and they are not rare in the pituitary. Their cells never excrete with such activity as to cause respectively the features of exophthalmic goitre or acromegaly. But in the pituitary they induce early pressure symptoms, bitemporal headache by distension of the dura mater enveloping the sella turcica, blindness or temporal hemianopia by pressure on the optic chiasma, and often subpituitarism by pressure on the rest of the healthy gland. Surgical treatment must be early, to preserve sight and save the gland. Cushing performs a sellar decompression, driving a tunnel from a submucous incision beneath the upper lip, up through the septum nasi and the sphenoidal sinuses, to expose the gland by reflecting its dura mater. This allows the adenoma to grow downwards, and as a rule suffices. Sight returns in a few days with the escape of the optic nerve from pressure.

Cushing describes in all forty-seven clinical cases of pituitary disease, of which twenty were proved by the microscope to be due to adenomatous growths causing subpituitarism. Of these forty-seven, 10 per cent. were Jews. The question is not raised, but it would be interesting to learn whether Jews as a race are particularly liable to pituitary derangements.

The Adrenal Glands.

It was in respect of these organs that the riddle of the ductless glands was first proposed by Addison's clinical observations in the disease that has since borne his name; and physiological work of the last twenty years, aided by the arguments of developmental anatomy, has won far clearer knowledge of the adrenals than it has of the other ductless glands. In this instance physiology has outstripped clinical pathology, while the latter has been unable as yet to make use of the

[1] Cushing employs a dry powdered extract obtained after passage of the entire fresh bovine gland through a Buchner press. Of this 30 grains may be given daily, that is the equivalent each day of about 150 entire fresh pituitary glands. This corresponds roughly to 1,500 daily of Burroughs and Wellcome's tabloids, of which 10 contain the extractives of one entire gland. Cases of subpituitarism are very tolerant of sugar, from which Cushing deduces a test for the adequacy of the treatment, namely, that pituitary extract shall be pushed until sugar appears in the urine on a meal of 150 grm. of dextrose. This in one case required a daily consumption of 500 entire glands.

discoveries of the physiologist. But it is well to remember that even in this later work, as in all the advances of knowledge of the ductless glands, the first promptings came from clinical observations. George Oliver thought that he had observed constriction of the vessels at the wrist in man when suprarenal gland extract was taken by the mouth. Perhaps the observation was erroneous, but it inspired him to seek Schäfer's aid in testing its truth by direct records of the blood pressure in animals, and the result of their joint work opened up new country, which has since been intimately explored by the many investigators who followed in their footsteps.

Balfour recognized the chief landmark when he saw that the cells of the adrenal medulla are derived from the same source as those of the sympathetic ganglia. This, indeed, is the peculiar interest of the gland, that it is practically a part of the nervous system.

The nature of this relationship has been worked out chiefly by the Cambridge School of Physiology, where the brilliant paper by Gaskell [5] in 1886 lit an eager interest in the visceral nerves that year by year has given forth more light. Gaskell challenged the old teaching, founded on Bichat's academic generalizations, which regarded the vegetative or sympathetic nervous system as a self-sufficing machinery for regulating the affairs of the viscera and almost independent of the central nervous system. Nowadays it is difficult to realise how deeply rooted was this opinion thirty years ago, and how widely it influenced all thought of the time as an almost axiomatic truth. Gaskell restored the monarchy of the central nervous system, showing that all the knotted complexity of the visceral nerves could be unravelled into single constituent strands arising from the spinal cord and carrying the dominant impulses of its central control. His, too, was the first broad classification of the nerves efferent from the brain and spinal cord. He showed that, while the motor nerves to the striped muscles connected with the skeleton issue in all the anterior roots, those to the unstriped muscle of the blood-vessels and viscera and to gland-cells do not flow out in a continuous series of anterior roots down the length of the spinal cord, but appear in three divisions, which are separated one from the other by the nerve-roots of the fore and hind limb plexuses. These visceral nerves all bear ganglion-cell relays on their course from spinal cord to peripheral tissue; by that they are distinguished from the skeletal nerves, and to that is due the anatomical complexity of their distribution. Langley accomplished the difficult task of analysing all the finer details of these nervous tracts, and he has introduced a fresh

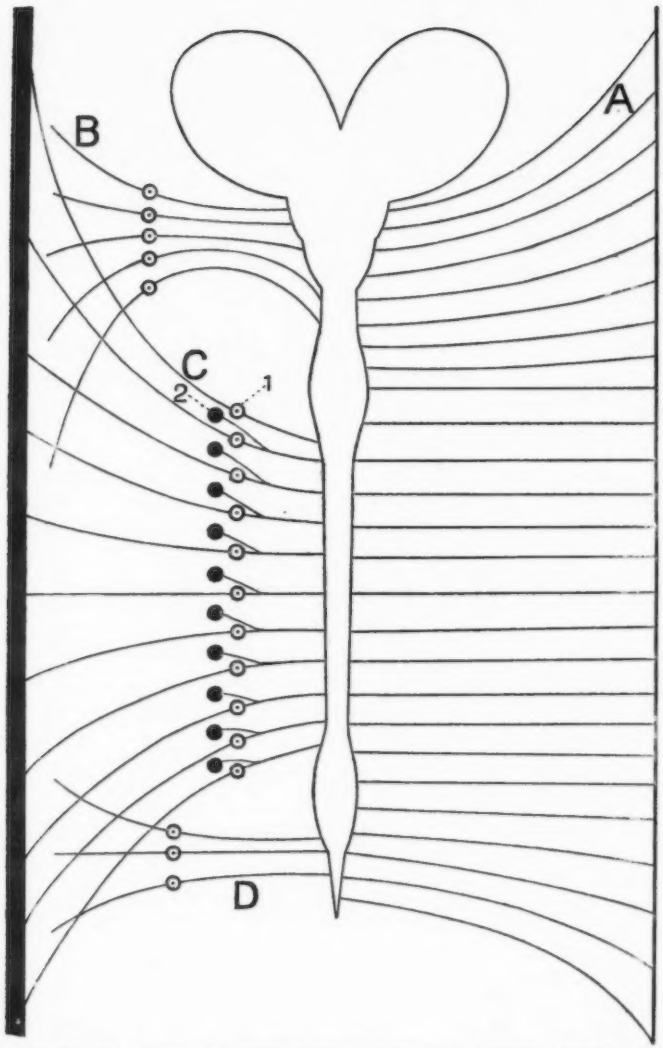

DIAGRAM OF THE NERVES EFFERENT FROM THE CENTRAL NERVOUS SYSTEM IN THE MAMMAL.

A, the non-ganglionated ordinary motor nerves to striped muscle, which are distributed segmentally. On the left side these are omitted for simplicity, and only the autonomic or ganglionated visceral nerves to plain muscle are indicated.

Of these, B is the cranio-cervical outflow in the vagus, &c.; C, the thoracico-lumbar or sympathetic proper; D, the sacral outflow, or pelvic visceral nerve to the bladder and colon. All these subdivisions contain both motor and inhibitory nerves.

C_1 is the sympathetic ganglion-cell; C_2 the paraganglion-cell secreting adrenalin, the chief mass of these being concentrated to form the medulla of the adrenal gland, though a few, even in adult life, may be found elsewhere in relation to the various sympathetic ganglia. The black rectangle innervated by the nerves from the cells C_1 represents the mass of plain muscle which is also stimulated by adrenalin, that is by the secretion of C_2.

Afferent sensory nerves and their posterior root ganglia are all omitted from the diagram. Their course from the viscera is not clearly known.

nomenclature, according to which the entire group of ganglionated visceral nerves is styled the autonomic system; in this are the three subdivisions of the cranio-cervical, the thoracico-lumbar, and the sacral root outflows (see diagram). To the thoracico-lumbar outflow is restricted the old term of the sympathetic.

Now the entire mass of plain muscle united with thoracico-lumbar or sympathetic nerves shows a remarkable reaction to the active principle extracted from the medullary cells of the adrenal. It, and it alone reacts to adrenalin; and the reaction is identical with that to electrical stimulation of the sympathetic nerves. This holds true both for contraction and for relaxation, and for muscles so far asunder in physiological differentiation as those of the rhythmically pulsatile heart or of the tenaciously closed sphincter urethræ. Further, the medullary cells have been shown to discharge adrenalin into the blood-stream, and to do so as the direct result of excitation of the splanchnic nerves which supply the glands. This they are continually doing in the various vascular reflexes.

It is therefore clear that there are two closely related types of cells connected with the primary preganglionic sympathetic fibres coming from the spinal cord:—

(1) The sympathetic ganglion cell, which is distally united with the plain muscle by its axon process, and so provides a path for the nervous impulse.

(2) The medullary or paraganglion-cell, which is not in connection with the muscle but is equally innervated from the spinal cord, and secretes a chemical substance into the blood that can produce an identical excitation of the muscle through its myoneural junction.

These cells (1) and (2), are as brother and sister to one another, being in the closest kinship of morphological parentage. Life can be maintained though all the ganglion-cells (1) are removed; death results from cardio-vascular failure when the adrenal glands, that is the cells of the cortex and cells (2) have been excised. In the moribund animal, after removal of the adrenal glands, stimulation of the vaso-constrictor nerves is almost without effect, because the muscles of the blood-vessels have lost their tone. It may be that the cells (1) and (2) were once identical, and that the liberation of adrenalin was an essential part of the nervous impulse; but now the two processes are carried out separately by separate anatomical units. The paraganglion-cell (2) excretes the adrenalin that maintains the muscle at a fair level of tone for its routine activities; the nervous impulse (1) effects the rapid

alterations from this level that may be required suddenly in special actions of the animal. Roughly, one may compare the muscle to the string of a violin that must be tightened up to its appropriate pitch before the fingers can evoke the rapidly changing notes.

Beyond such rough analysis knowledge has not yet advanced. A secret lies within this relationship of gland-cell to the efficiency of a nervous impulse, that may prove of the utmost value in explaining the processes of nervous activity. Given the solution of it, the formula of interaction between hormone and nervous impulse may perhaps be found capable of application to other departments of the central nervous system than the sympathetic, and a simple material explanation be obtained for such conditions as spinal neurasthenia. To describe a patient with Addison's disease as suffering from cardio-vascular neurasthenia, or from myasthenia gravis of the circulatory muscles is no wide stretch of the fancy.

The adrenal is, therefore, the ductless gland that promises most in the future to neurologists who seek for deeper acquaintance with the physiological processes of nervous activity. And it has been equally generous to historians of the past. Those who inquire into that most fascinating problem, the origin of the vertebrates, have read in the story of the adrenals clear proof that the thoracico-lumbar or sympathetic system is, in virtue of this reaction, a group distinct from the other visceral nerves, a stratum, so to speak, laid down at a probably later epoch and composed of its own peculiar materials.

As will be seen in the discussion of the thyroid gland, Continental physiologists have accepted this teaching of the English school with regard to the visceral nerves—it is described with admirable clearness in the second edition of Biedl—but at Vienna it has been extended to yield illegitimate conclusions with regard to the functions of the other ductless glands.

The adrenal gland is a compound of cortex with medulla. Both fail in Addison's disease, so that the cardio-vascular sympathetic fault carries with it some expression of the lack of cortical secretion. What that may be is still unknown. The cortical cells do not belong immediately to the sympathetic group; they secrete a doubly refractive fat of complex composition like that of the myelin sheath of nerves, but nothing can be said with regard to its function. However, the presence of this lipoid in abundance indicates a healthy gland. Cushing falls into the error of regarding it as a phenomenon of degeneration, and so an index that the adrenal as well as the pituitary was affected in some of the cases described by him.

Doubtless there are clinical conditions of superadrenalism due to excessive secretion, but they have not been identified, though frequent endeavours have been made to prove that persistently high blood-pressure should be ascribed to this cause.

On the other hand, overgrowth of the cortex in children, producing large adrenal tumours [1], is beyond doubt associated with sexual precocity, premature adolescence, and an early setting of the body, the very opposite of juvenile acromegaly. As a mysterious oddity may be quoted the fact that the human adrenal is distinguished from that of all other animals by a great overgrowth of the cortex in fœtal life; this overgrowth does not occur in cases of hemicephaly, congenital fault that has led to absence of the cerebral hemispheres and reduced the child to the level of the brainless beasts [4].

Simple adenomata of the cortex are very frequent in the adrenal, as they are in the other ductless glands. They cause no pressure symptoms and no clinical phenomena.

The Thyroid Gland.

In this gland clinical workers first recognised the three main forms of pathological disorder, that have since served as types for the study of changes in the other ductless glands. They are superthyroidism, or Graves's disease; subthyroidism, or myxœdema and cretinism; and adenomata causing pressure symptoms. The adenomata and the parenchymatous goitres are localized or general enlargements of gland tissue, which do not produce secretion proportional to the increase of bulk, and may perhaps be regarded as anatomical evidence that the gland has been striving under adverse conditions to do its proper physiological work.

But there are two chief problems still unsolved, despite much study in the laboratories of experimental research. In the first place arises the question, what is the nature and meaning of the thyroid secretion? Its absence hinders growth, its presence hastens metabolism; with either change curious and special nervous phenomena are seen. Secondly, analysis is perplexed by the double nature of the gland. All the ductless glands, pituitary, adrenal, thyroid, pancreas, and testicle, present this difficulty; two types of cells living in close neighbourhood, often under the same roof, and yet with no obvious reason why they should have chosen such a union.

The associate of the thyroid is the smaller group of parathyroid glands. To them, but without sufficient proof, has been ascribed the

train of nervous symptoms that appear when the thyroid is removed. The leading feature of this condition of tetany is an exaggerated excitability of the skeletal muscles through their motor nerves. Many workers have proved that calcium salts in general lower neuro-muscular irritability, and the deduction led to the observation that after removal of the thyroid and parathyroids there is an excessive loss of calcium from the body, a so-called calcium diabetes [9]. This, however, does not seem to be the full explanation of the trouble, for while calcium salts allay tetany after removal of the thyroid, they do not serve to prolong life. Further, it has been urged, but without the least attempt at proof, that all forms of tetany are due to subparathyroidism; and that even myotonia congenita and paralysis agitans are caused by a slow, progressive diminution of parathyroid secretion, while myasthenia gravis is the result of excessive parathyroid activity. This is pretty imagining, but at present bears no relation to substantial fact.

Even with regard to the first question, what is the meaning of the thyroid secretion, little definite can be said. The view that it is required to neutralise certain poisons formed in the metabolism of the body has now few adherents. It is admitted that the thyroid secretes into the blood some substance which influences the heart and the nervous system and growth; that is, it produces one of Starling and Bayliss's hormones, belonging to the same group of simple though potent non-protein bodies as adrenalin, pituitrin, and secretin. Now the Viennese school has elaborated a doctrine with regard to the hormones that is essentially inspired by Ewald Hering's theory of nervous control. The first instances observed of the activity of these bodies were naturally those of stimulation, where a muscle was made to contract or a gland cell to secrete, as in the original discovery of the action of secretin on the pancreas. But adrenalin inhibits some muscles while it causes contraction of others. Hence is deduced the view that a hormone may be purely inhibitory, and, according to Hering's view of inhibition, is therefore a chemical agent which excites an assimilatory process in other organs—in other words, it causes growth. Out of this philosophical analysis of assimilatory and dissimilatory, or inhibiting and exciting hormones, and from a conjectural relationship of the ductless glands to other parts of the visceral nervous system corresponding to the proved association between the adrenals and the sympathetic, have arisen curiously intricate statements of function. They are chiefly taught by Falta and other clinical investigators in Vienna, and they are quoted repeatedly in Biedl's book.

Thus (p. 420) removal of the pancreas removes an inhibitory hormone which it is supposed to form, and consequently the thyroid finds the tissues freed from this constraint and can exert without hindrance its power to accelerate metabolism by its own dissimilatory hormone. Reference will be made again later to this attractive study of the balancing of the body within as well as without, the view that just as our equipoise in standing or in walking depends on the adjustment of nervous impulses, motor and also, as Sherrington has so brilliantly shown, inhibitory towards the many muscles concerned in the posture, so, too, the equilibrium of metabolism and the delicate adjustments of growth, that so marvellously round the whole into the symmetry of adult life, are evidence that the balance of power is fairly adjusted in the concert of the ductless glands, and that no hormone precludes his fellow from a place in the sun of vital growth.

The theory enunciated by Falta and Rudinger as to the actual function of the thyroid secretion is this. Thyroid and parathyroid oppose one another; the former stimulates the sympathetic nerves, the latter inhibits them. Pancreas is associated with parathyroid in retarding metabolism, while thyroid and adrenals augment it. Hence loss of the thyroid leads to:—

(1) Loss of its secretion, and therefore slowed metabolism.

(2) Absence of stimulation of the adrenals.

(3) Escape of the pancreas from inhibition.

(4) Decreased excitability of the nerve which is supposed to innervate the thyroid, that is the vagus, in all its area of distribution.

All this is visionary, and a discussion of it would be profitless at present. More facts are wanted.

Pluriglandular Insufficiency.

Increasing emphasis has been laid in the last few years on the need to look upon the ductless glands as parts of a connected whole, so that one gland can neither fall out by the wayside nor grow tenfold in bulk without the others showing consequent change. Careless clinical analysis is apt to accept this readily, and, beneath the ugly phrase of "polyglandular syndrome," to cover ignorance of the cause of pigmentation, of obesity, glycosuria, or gigantism by a general reference to some one or other in the ring of ductless glands, of which nothing is known with certainty.

But the original view of the matter has good justification. The ductless glands do bear some functional relationship one to another;

normal health and growth swing in the equal balance of their activities, and damage of one is likely to result in altered action of another, so that the ultimate bodily change shows the plus of B as well as the minus of A. To name a few common features, which suggest a common bond:—

(1) Carbohydrate metabolism is influenced by all. On ordinary diet sugar appears in the urine when the pancreas is damaged; in exophthalmic goitre, when the thyroid is over active; in acromegaly, that is presumably with superpituitarism; and lastly, by injection of adrenalin or stimulation of the splanchnic nerves to the adrenals. On the other hand, sugar tolerance is exhibited by patients with subglandular conditions of pituitary, thyroid, or adrenal. The correlation may be explained directly or indirectly. Thus in exophthalmic goitre the state of nervous fright may be exciting the adrenals through the splanchnics and so leading to glycosuria; that is, the fright is due to the thyroid, and the glycosuria is a secondary expression of this.

(2) Bodily growth and general metabolism. With the development of the testicle, especially of its interstitial cells, the individual is consolidated and longitudinal growth checked. This process is accelerated to an amazing degree when the cortex of the adrenal is hypertrophied; it is arrested in the dwarfish cretin with atrophied thyroid, and sexual ability fails alike with the acromegalic giant and with obese examples of subpituitarism.

(3) Nervous implications are less obvious. Tetany is a result of sudden thyroid or parathyroid loss. There is nothing corresponding to the clear connexion of the adrenal medulla with the sympathetic nervous impulses.

(4) Association between the glands themselves. The pituitary becomes hypertrophied when the thyroid is removed. Acromegaly frequently leads, in its later stages, to enlargement of the thyroid. Thyroid extract is found to be a useful remedy in acromegaly, even for the amblyopia of that disease.

(5) The double anatomical constitution of all the glands is a morphological chance that does not enter into the question. So, too, no stress can be laid upon the fact that an active principle of simple molecular constitution, which is not destroyed by boiling, can be extracted from the adrenal, the pituitary, and apparently from the thyroid and pancreas.

The adrenal cortex and the interstitial cells of the testicle secrete a special fatty substance; the thyroid and pituitary a special colloid. But the lipoid and the colloid are probably different substances in each case. Certainly that of the pituitary does not contain iodine.

(6) Morphological relationship. This argument, when it can be applied, is one of great weight to emphasize a likeness of function. But the work done in comparative physiology and that in morphology is accumulated in separate islands of thought, and few have sought to cross the estranging sea. Gaskell, on morphological grounds [6] classifies together the pituitary, thyroid, and adrenal cortex as being all modified from the coxal glands, that is the segmental excretory apparatus of some primitive arthropod type. This suggests that these ductless glands may be found to have physiological activities that are more closely related to each other than some workers would at present care to admit.

Indeed the question of the relationship to one another of the ductless glands is one of subtle intricacy, which needs the clearest thought and more proved facts for a right judgment to be made. Hypotheses serve to direct the search this way and that, and through them more evidence is brought to light and tested. But confusion will disorder all, if theory and analogy be permitted to develop a statement and this be too early accepted as conclusive. The teaching of the Viennese school, despite its brilliant suggestiveness, carries with it that dangerous fault, for it has been elaborated far beyond the facts. There is not a shadow of proof that the thyroid has any special and peculiar relation to the vagus nerve, like that of the adrenals to the sympathetic. Drugs, such as pilocarpine and atropine, cannot be classified with regard to their action upon different departments of the nervous system as rigidly as can adrenalin. Rightly to explain clinical observations is hard enough, even when one uses the proved truths of physiology and pathology; error is unavoidable, if the deduction is made from error. The apparent simplicity of a generalization will always recommend it to medicine, impatient for aid to comprehend the instant problems of disease. But the speculative nature of Falta's views should be properly appreciated, lest on them too much be built and much weary work of reconstruction be called for later, if the foundations fail.

The essential facts and the broad laws concerned with the activities of the visceral nervous system have been mainly ascertained by experimental work in England. As it chanced, this study of the visceral nerves was almost hindered in its progress by the necessity of devising at each step experiments to demonstrate the error of a general law which had been formulated in Vienna by von Basch, the law of crossed innervation of the longitudinal and circular coats of plain muscle in hollow viscera. The law was absolutely unproven, but it was

so engagingly simple that it was accepted without question as it stood, to be the working creed of many medical writers. Its removal cost much labour, and now the cleared ground is threatened afresh. Medicine owes no debt of gratitude to those who teach to her theories without proof.

Still these views, and particularly Biedl's book, will do good service, insomuch as they emphasize the problems to be solved. We see how widely and deeply the influence of the ductless glands penetrates through the busy factories of life. But the how and the why of it all is chiefly a mystery still. The reading of the riddle must increase man's power to help man.

T. R. Elliott.

REFERENCES.

[1] Bullock and Sequeira. *Trans. Path. Soc. Lond.*, 1905, vol. lvi, p. 189.
[2] Cushing, Weed and Jacobson. *Johns Hopkins Hospital Bulletin*, February, 1913.
[3] Dale. *Biochemical Journ.*, 1909, vol. iv, p. 427.
[4] Elliott and Armour. *Journ. Path. and Bact.*, 1911, vol. xv, p. 481.
[5] Gaskell. *Journ. Physiol.*, 1886, vol. vii, p. 1.
[6] *Idem.* "The Origin of Vertebrates," London, 1908, p. 430.
[7] Herring. *Quart. Journ. Exp. Physiol.*, 1908.
[8] Horsley and Handelsmann. *Brit. Med. Journ.*, November 4, 1911.
[9] MacCallum and Voightlin. *Johns Hopkins Hospital Bulletin*, March, 1908.
[10] Schäfer. Croonian Lecture, *Proc. Roy. Soc.*, 1909, vol. lxxxi, p. 442, and *Proc. Roy. Soc. Med.* (Neurol. Sect.), March, 1913.

Publications Recently Received.

[*Notes on a book under this heading do not preclude a subsequent review.*]

Die Vasomotorisch-trophischen Neurosen. Eine Monographie. Von Dr. R. Cassirer. Zweite umgearbeitete und vermehrte Auflage. S. 988, mit 24 Abbildungen im Text und 24 Tafeln. Berlin: Karger, 1912.

This extremely important monograph contains all that is known of the vasomotor and trophic neuroses admirably arranged for reference. The first chapter deals with the anatomy and physiology of vasomotor and secretory mechanisms, and with the trophic functions of the nervous system; acroparæsthesia, erythromelalgia, Raynaud's disease, acro-asphyxia chronica, sclerodermia, acute local œdema, and multiple neuropathic gangrene of the skin, are all treated in a series of chapters, each of which is a monograph in itself. The list of papers alluded to in the various chapters occupies nearly 100 pages and is admirably arranged, but unfortunately there is no general index. This book is indispensable for every medical library and for all who are interested in the vasomotor and trophic neuroses.

Die klinische Stellung der sogenannten genuinen Epilepsie. Von E. Redlich und O. Binswanger. S. 146. Berlin: Karger, 1913.

The two separate reports presented by Redlich and Binswanger to the meeting of the German Neurological Society at Hamburg in 1912 are reprinted here. Redlich's occupies 124 pages and contains a complete bibliography of the recent and more important papers on epilepsy. He found the definition of his subject "genuine or true epilepsy" very difficult, and suggests that this title should be dropped, but his broad-minded view of the condition generally included in it will be acceptable to most clinicians. The various etiological factors to which the disease may be due, or to which it has been attributed, are fully discussed, and their possible pathological significance is considered. He regards epilepsy as an organic cerebral disease though its essential anatomy is still uncertain. The clinical features of the disease and the mutual relationships of the different clinical forms of epilepsy are also fully considered.

Binswanger deals chiefly with the histological changes found in epileptic brains and their significance, but he still holds that there is no satisfactory evidence that epilepsy is an organic cerebral disease.

L'Aphasie Motrice Pure. Par ANDRÉ PÉLISSIER. Pp. 198. Paris: Vigot Frères, 1912.

The author, a pupil of Dejerine, carried out in the Salpêtrière the clinical and pathological investigations on which this monograph is based. By pure motor aphasia he understands a more or less complete inability to articulate words which is not due to a paresis or ataxia of the muscles of articulation, and is not associated with any disturbance of other elements of speech. He brings this form of speech disturbance into contrast with Broca's aphasia in which internal speech is always effected to some extent, but he admits that a sharp line cannot be drawn between them. Pure motor aphasia may be produced by either cortical or subcortical lesions; the cortical centre (to the disturbance of which it may be due) is apparently always Broca's area.

The monograph can be strongly recommended as a concise and intelligent contribution to the affection of the motor side of speech.

Hysterische Lähmungen; Studien über ihre Pathophysiologie und Klinik. S. 174. Von H. DI GASPERO. Berlin: Julius Springer, 1912.

This book, which is published from the office of the *Zeitschrift für Gesamte Neurologie und Psychiatrie* is an interesting and valuable contribution to the study of isolated hysterical palsies. The clinical symptoms and the nature of the functional disturbances are carefully and elaborately described, but the pages which will probably prove most interesting and instructive are those which deal with the vasomotor state of the affected limbs. The author, by means of the plethysmograph, compared the vascular reactions in the palsied and the corresponding normal limb to various sensory and psychical affects, and was able to demonstrate remarkable differences. Further, he found that the vessels of the abnormal limb reacted differently to the vessels of the normal limb on inhalation of amyl nitrite and adrenalin injections. The book deserves careful study.

Le Ramollissement Cérébral (Étude anatomo-clinique et expérimentale) Diagnostic entre le Ramollissement et l'Encéphalite. Par HENRI SCHAEFFER. Pp. 168. Paris: G. Steinheil, 1910.

The most interesting feature of this monograph is a detailed comparison of the histological changes produced by aseptic and septic emboli of the cerebral vessels. The work was carried out by producing experimental embolism in animals and by pathological observations on the human brain; it contains perhaps little that is new, but the care with which the histological examinations were evidently made and their lucid description recommend the book strongly to all interested in cerebral pathology. The much debated question of the origin of the *corps granuleux* (Körnchenzellen) is fully considered; the author believes they may be derived from the blood, from the vascular connective tissue, or from the neuroglia.

A Clinical Study of Acute Poliomyelitis. By F. W. PEABODY, M.D., GEORGE DRAPER, M.D., and A. R. DOCHEZ, M.D. [Monographs of the Rockefeller Institute for Medical Research.] Pp. 187, with 13 plates. New York: Rockefeller Institute, 1912.

This clinical study is based upon 183 cases of acute poliomyelitis admitted to the Rockefeller Institute. A short account is given of the nature of the virus and the pathological anatomy of the disease, but the greater part of the book is devoted to an analysis of its clinical manifestations. The authors divide their cases into three groups: the abortive form where the infection does not result in paralysis; the rare cerebral group which ends in spastic paralysis; and, lastly, the bulbo-spinal group which contains the majority of cases. The case-reports are admirably full and clear, and the illustrations excellent.

Selected Papers on Hysteria and Other Psychoneuroses. By Professor SIGMUND FREUD. Second Edition, translated by A. A. Brill, M.D. Pp. 215. New York: Journal of Nervous and Mental Diseases Publishing Company, 1912.

This is a second English edition of Freud's collected papers. It contains the original preliminary communication on the "Psychic Mechanism of Hysterical Phenomena," written in conjunction with Breuer. This is followed by the story of "Lucy R.," in which is laid bare the origin of certain hallucinations of smell, and the well-known case of hysterical pains in the legs, "Elizabeth v. R." The next chapter, on the "Psychotherapy of Hysteria," reveals the lines along which Freud developed after separation from Breuer, and after he had given up hypnosis as a necessary preliminary to analysis treatment. Then follows a chapter on the "Defence Neuropychoses" in which the theory of phobias and obsessions as protective reactions is laid down, and, after a short statement of Freud's views on the rôle of sexuality in the etiology of the neuroses, the book ends with a paper concerning "wild," or, as we should say, "far-fetched," psycho-analysis. All who are anxious to learn the views of Freud himself, as opposed to those of his followers, should study this book, which contains the best of his papers. The translation is on the whole remarkably good.

Les Syncinésies. Par le Docteur G. STROEHLIN. Pp. 147. Paris: G. Steinheil, 1911.

This is a study of associated movements and the various conditions under which they may appear. After alluding to the impossibility of rotating the hands in opposite directions, and other similar associated movements in normal human beings, the author considers their appearance in "*débilité motrice*," a term which signifies any condition accompanied by diminished

inhibitory action on the part of the pyramidal tract. He concludes that in primitive stages of development, movements were bilateral and symmetrical, and that during certain pathological conditions, such as infantile hemiplegia or adult hemiparesis, this bilateral character may reappear. Such associated movements occur solely in high pyramidal lesions and not with spinal or peripheral paralysis; they are the consequence of defective cortical inhibition on the side of the lesion, combined with over-action of the opposite cortex.

Manisch-depressives und periodisches Irresein als Erscheinungsform der Katatonie. Eine Monographie. Von Dr. MAURYCY URSTEIN. S. 650. Berlin, Wien: Urban und Schwarzenberg, 1912.

This book is written in continuation of the author's previous work on dementia præcox [*vide* BRAIN, 1909, vol., xxxii., p. 482]. It consists mainly of a series of most elaborate clinical histories extending in some cases over thirty to forty years. This long-continued observation was possible owing to the excellent system of case-reports initiated by Heinrich Laehr at Schweizenhof Asylum in Zehlendorf; these admirable notes were given over to the author for study by the present superintendent. Each report ends in a summary description of the case, and the conclusions to be drawn from it. In the last hundred pages, the author sums up the symptoms, causes and prognosis in katatonia, and lays stress on the thesis, that maniacal depressive and circular psychoses may be phenomena of dementia præcox.

Writers of "Original Articles and Clinical Cases" are supplied free of charge with 50 copies reprinted in the form in which the paper stands in the pages of "Brain." If reprints are required in pamphlet form, with wrapper, title-page, &c., and re-numbered pages, they must be ordered, at the expense of the writers, from Messrs. BALE, SONS & DANIELSSON, Ltd., 83-91, Great Titchfield Street, London, W.

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To those who are not members of the Neurological Section of the Royal Society of Medicine the price is 8s. 6d. net, and the volume may be obtained through any bookseller.

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